SUPPLEMENT
TO THE
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WATER SUPPLY, & SANITARY IMPROVEMENT.

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Parliamentary Intelligence.

HOUSE OF COMMONS.

THURSDAY, MAY 31, 1877.

The Lords amendments to the Longton Corporation, Middlesbrough Corporation, and Sittingbourne Gas Bills were agreed to.

The Bishop Auckland District Gas, Bristol United Gas, and Glasgow Corporation Water Bills were read the third time and passed.

The following Bills, as amended, were considered:—Burslem Local Board; Carshalton Gas; Christchurch Gas; Lowestoft Water, Gas, and Market (Lords).

The Newcastle-under-Lyme Borough Extension and Improvement and Southend Gas Bills, as amended, were considered and amendments made.

The Examiners reported that the Standing Orders not previously inquired into have been complied with in the case of the Blackburn Borough Gas, Water, and Extension Bill (Lords).

The Local Government (Gas) Provisional Orders (Penrith, &c.) Bill was considered in committee, and reported without amendments.

FRIDAY, JUNE 1.

The Woolwich, Plumstead, and Charlton Consumers Gas Bill was reported.

The Lords amendments to the Warrington Corporation Gas Bill were agreed to.

The Bridgwater Corporation Water Bill, as amended, was considered.

HOUSE OF COMMONS COMMITTEE.

THURSDAY, MAY 3.

(*Before Mr.* D. R. PLUNKET, *Chairman; Mr.* FOLJAMBE, *Mr.* STARKEY, *and Mr.* COURTNEY.)

CRYSTAL PALACE DISTRICT GAS BILL.

(*Continued from p.* 864.)

Professor *Frederick Settle Barff*, examined by Mr. CRIPPS.

I am Professor of Chemistry to the Royal Academy of Arts, and I have made it my business to examine into the causes which have an injurious influence upon pictures. I have found in those investigations that the products of the combustion of coal gas are injurious to them—as far as I can trace it to them; and I think I can. In London, where gas is purified from sulphuretted hydrogen, I do not find that the blacking of the white lead goes on as in places where that purification has not taken place. If, however, that happens, it is a matter which can be remedied. By washing the defective picture with peroxide of hydrogen I can restore the colour, if it is not too far gone.

Mr. CRIPPS: Now what have you found to be the effect of the combustion of the sulphur in the London gas?

Witness: Sulphurous acid gas is formed by the combustion. That sulphurous acid gas comes in contact with the moisture in the air, and gets oxidized very very rapidly, and becomes sulphuric acid; and the sulphuric acid is not a volatile thing which will go away like sulphurous acid, but it mixes along with the moisture of the room, and deposits upon the cold parts of the room, as moisture does that is usually upon the walls. If it gets upon the walls, it will get on the pictures; and if it gets on the pictures, it has, in my opinion, this effect. First of all upon water colours. Ultramarine is a colour which is affected, and is perfectly destroyed by moderately strong sulphuric acid, and is gradually destroyed with excessively dilute sulphuric acid; therefore, if it comes in contact with the ultramarine, it simply destroys the colour perfectly, though slowly. After a time it will act upon zinc oxide. Now zinc oxide, or zinc white as it is called, is a thing which is generally used as a pigment among artists at the present time; and the action, if a picture is unprotected, is to convert a portion of the zinc oxide, which is opaque, into zinc sulphate, which is a tolerably crystalline substance; and this substance I have found upon the paintings of several artists, I think Mr. Frith's, with several others I do not remember. As I was called here to-day without the slightest warning, I only got the information early this morning, and I have not been able to verify the names. Therefore I must say I *think*; but in several of the paintings, where the zinc white has crystallized and become soluble it can be seen by the microscope. This, of course, interfered with the opacity of the picture, and therefore destroyed its effect, besides making it spotty. I attribute that to the presence of sulphuric acid.

By the COMMITTEE: Mr. Frith wrote to me, when I was staying at Cromer, in the summer of last year, as to a picture, and I wrote to him to that effect. It is an opinion which I formed and expressed quite independently of the present inquiry.

Mr. CRIPPS: With reference to canvas also, on which so many pictures are painted, what do you say as to the effect upon canvas?

Witness: I have a difficulty in getting a picture to experiment upon, but I have taken a piece of canvas and exposed it to the action of excessively dilute sulphuric acid for a long time, and this I have shown in my lectures for the last six years at the Royal Academy, and I have shown the students that by keeping this stretched and tapping it, you will be able to knock the canvas through, and a portion of it will come away in dust, quite rotten. I attribute that to sulphuric acid mainly. We know in our laboratory that sulphuric acid does do this. It rots our cloths perfectly. If a picture be covered with mastic varnish, I know from experiment that dilute sulphuric acid is injurious. Mastic varnish is a varnish which takes up moisture, and gives a sort of bloom to the picture which artists do not at all like; and that bloom is owing to the hygroscopic character of the mastic varnish. Then, if sulphuric acid is in the room, and I think there can be no doubt that it is, and if it cannot get out of the room, and if it is not carried away by the draughts, it must settle somewhere, and it must, among other places, settle upon this mastic varnish; and if it does settle upon it, the effect is to corrode its surface, and take away the bloom; and if the surface be corroded, the picture readily gets dirty, and has to be varnished again. I have made experiments upon a bad painting, done on purpose for experimenting upon, to see what the effect of this might be upon it. The result has been to destroy the ultramarine slowly, and to interfere materially with the zinc white. I cannot say anything as to the other colours, except the iron colours; I think they have been damaged by it, for they, being oxides of iron, would be dissolved up in part by the dilute sulphuric acid, and would therefore be injured, and I think I have noticed traces of injury on the oxides of iron.

Have you, in consequence of the state of the pictures that are in your own drawing-room, been led to give up the use of gas for those reasons?—Yes; since I have bought valuable pictures I have had a gas-burner made with the pipe going into the flue, and another pipe coming from the outside, so that the whole of the particles of combustion are carried away. In my drawing-room I have given gas up altogether, and use nothing but lamps. I found that injurious effects were produced from the gas in the room before it was done away with. Nearly all the friends I have who come notice the difference between the sensation of spending an evening in the room now to that which they felt when they spent an evening in the room before. I have now two 22-candle Silber Argand burners, and before I had only two 3-light bat's-wing burners.

In your lectures at the Royal Academy have you proved the production of those products in the combustion of gas?—Yes. I pass the products of combustion from coal gas, developed by means of an apparatus, through baryta water. I then dissolve up the white precipitate, which is mainly carbonate, in hydrochloric acid. I then have a sulphite of baryta in solution, and I add that to the chlorine water, which oxydizes the sulphite into sulphate, and throws it down as a white insoluble precipitate, and in this way I have determined approximately the quantity of sulphur burnt in the gas from the sulphide of carbon.

I believe that you generally advise artists to give up the use of gas in their studios?—Every one; all the members of the Royal Academy I have advised to do so, and all the students who have applied to me I have advised to give it up, or else to use the arrangement which I have—which is an adaptation of the one that existed before—to carry off the products of combustion.

Is the reason that you give that advice because you think that the sulphuric acid from the sulphur compounds which you detected is injurious?—Certainly, and for no other reasons; because there is no sulphuretted hydrogen in the London gas.

Cross-examined by Mr. PHILBRICK: My judgment is that the combustion of gas, unless under favourable circumstances, is always, more or less, attended with injury to pictures, because there is an amount of bisulphide of carbon in it. I have never tested the difference between 15 or 16 and 40 grains per 100 cubic feet of sulphide of carbon. The ventilating apparatus in my house is a very costly thing; it is not within the reach of many people. The whole apparatus cost me about £45. In the national collections gas is very rarely burned. It is burned at the Royal Academy, but there it is all in sunlights. The ventilation there is not very efficient. I think there are no injurious results produced upon the works of art in the room; at least I am not competent to speak about that, because I have never been referred to, nor been shown any of the pictures.

Mr. PHILBRICK: Then I may take it that, with regard to the national collections, and matters that come officially under you, there has been no complaint of damage from that?

Witness: But I have no official connexion with the national collections. I have nothing to do with the National Gallery; it is only with the Royal Academy.

I do not know whether you are aware that the lighting of the Vernon collection of pictures was fully considered by a committee of scientific men?—Yes, I am.

Was the result of that that gas illumination was adopted?—That I am not prepared to say. I do not know how it is lighted. I confine my attention to my own work at the Royal Academy. I cannot speak to any of the national collections at all.

Cross-examination continued: If you treat with diluted sulphuric acid the pigments ultramarine and zinc white and the compounds that have an iron basis, you may destroy them more or less. You may also in that way destroy the fibre of hemp. Mastic varnish practically requires to be renewed very often. The only thing is that artists put it off because they do not like sending their pictures to varnishers, and they do complain that I have introduced at the Royal Academy a new system of varnishing to get rid of that. An artist does not even like to varnish his picture himself until it has stood for some years for the oil to get hard. Mastic varnish is almost invariably used, because there is no other. They cannot very well use copal; it is a bad varnish for pictures, as it has a habit of dragging the colours underneath if they are not sufficiently hard. You may have seen in art galleries a number of pictures cracked; that is mainly owing to the fact of the varnish being used in too large quantities on a colour which is not sufficiently hardened. To prevent that, mastic is usually had recourse to as being more elastic. I do not know whether pictures in country towns, where gas is not subject to the same conditions which prevail in London, suffer more from the effect of sulphur compounds than pictures exposed to London gas. I do not know whether pictures that are hung high up on walls suffer more than those on the level of the dado. When pictures are sent to me for examination they are always placed on the level, and I cannot tell where they may have been. I have never noticed

whether the gilding of the frames of pictures has been differently affected according to the positions in which they have been hung. I should prefer to hang them on the dado than above it. No doubt the heat itself in the upper part of a room will produce some of the injuries I have mentioned; it will injure the varnish.

Mr. PHILBRICK: You would say if there were the presence of sulphur or sulphuric acid, that, of course, would aggravate it, though the heat would bring it up?

Witness: If it is not troubling you too much, I should like to say a word upon that. In the varnish of a picture you have got different media—you have got one substance that contracts at one temperature, and another substance that contracts at another temperature, a little lower, probably. Those varnishes are not good conductors of heat, and the consequence is that when the varnish gets hot it expands, and is by the heat itself driven through to the canvas below it, and consequently it has a tendency to crack; and I believe that the dry heat in the upper part of the room has a very great effect in producing cracks in pictures, owing to the unequal expansion and contraction of the two materials—the layer of varnish and the layer of paint.

That dry heat, of course, to produce sulphuric acid and sulphur compounds, if sulphurous acid is present, requires moisture?—Exactly so; certainly. Of course, if you had no moisture in the room you would have no sulphuric acid formed, for the sulphurous acid will not oxidize at a high temperature.

That explains what somebody said yesterday, that where there was a drier heat the sulphurous acid has not become sulphuric?—No; but in a room where this is continually going on, at the same time that you have moisture of water, or water vapour, in the room to a large extent, that gets deposited on the walls, and I think the point that should be recollected is that sulphuric acid when once formed remains there and accumulates.

Re-examined by Mr. CRIPPS: The heat alone of a dry atmosphere may do some mischief to the pictures. What I am speaking of is the further injury that I attribute to the action of the combustion of gas. I put the two things on two different footings altogether, one being a matter which probably cannot be prevented—the heat in the room—and the other a matter that, if it can be prevented, I think ought to be prevented. If the varnish cracks on a picture, of course the paint underneath gets exposed, and is much more likely to be acted upon by deleterious influences in the air. I have never been at South Kensington Museum in the evening when it was lighted up. I have been there at two *conversaziones*, but I have never seen the pictures lighted.

Mr. *William Charles Young*, examined by Mr. CRIPPS.

I am a Fellow of the Chemical Society, and have been analyst for the Poplar District, and a gas examiner at the Beckton testing-station for the last five years for the Metropolitan Board of Works. For the last nine years I have been almost daily engaged in testing gas to examine its purity and illuminating power. For the last three years I have occasionally made experiments to determine whether the sulphur in the gas when burnt is converted into sulphuric acid or sulphurous acid; and the result of my experiments has been to convince me that practically the whole of the sulphur is converted into sulphuric acid, and not into sulphurous only. I attribute very much of the injury caused to furniture and to bookbindings, and, in fact, anything which is said to be injured by the gas, to the sulphuric acid that is produced by combustion of the sulphur. I have noticed, where gas has been burning, that brass fittings in rooms have become coated with sulphate of copper; that zinc has become coated with sulphate of zinc; and this could only be after the sulphur had been converted into sulphuric acid. I have noticed that the surface of painted walls and furniture is distinctly acid, and that the acid is sulphuric acid. I have also noticed as to dust collected in rooms where gas has been continually burnt, and no fire has been lit, that the dust was distinctly acid, and that the acid is sulphuric acid; and I have estimated the acid as sulphuric acid from dust taken from the top of a wardrobe cupboard in a bed-room where gas only has been burnt. The acid found there was equal to ·335; that is rather more than three-tenths of a grain of sulphuric acid per square foot of cupboard. Taking the four walls only, and supposing it to be evenly distributed over the walls of the room, I calculated that it would be equal to two grains of sulphur, in every 100 cubic feet of gas, deposited as sulphuric acid. Supposing that which I found was upon every square foot of surface forming the four walls, I should have got sufficient sulphuric acid to indicate that two grains of the total sulphur in the gas burnt was converted into sulphuric acid and deposited upon the walls. The dust which I experimented upon has remained undisturbed upon the shelf for six months, and I calculated there would be rather more than 2000 cubic feet of gas burnt in that time. I cut a piece of the top of the canopy from the top of the bed-hangings, which had been there six months, and I estimated the acid in it as sulphuric acid, and I found nearly half a grain of sulphuric acid per square foot. That, if calculated for the same amount of surface in the same way, would indicate that three grains of sulphur had been deposited per 100 cubic feet of gas burnt; and I think that that is more accurate than the other experiment, because, in the first place, the sulphuric acid absorbed by the wood upon which the dust had collected was not taken into account—the dust was merely swept off the surface of the wood; but in this second experiment, the whole of the sulphuric acid was taken into account, the sulphuric acid that was absorbed by the fabric as well as in the dust lying upon the fabric. A considerable quantity might be taken up by the carbonate of lime in the ceiling in the other case. If the amount could be ascertained that was taken up by the ceiling and of that which was removed from the room by ventilation, I have no doubt that the whole of the sulphur could be accounted for as sulphuric acid in all the gas that had been burnt. I also tested for sulphuric acid upon some advertisement cards that had been exposed in a shop for some time.

Mr. COURTNEY: Before you go away from the room you spoke of, do you happen to know whether the gas supplied in that room was supplied under the 20 grain regulation, or under any regulation?

Witness: No, I believe there is no restriction—the gas was supplied from the Silvertown works of The Gaslight and Coke Company; and I think there is no restriction there as to sulphur impurities.

Mr. PHILBRICK: That is not so.

Mr. CRIPPS: It will be sufficient to let me know where it came from?

Witness: I was under that impression. I know that it is not tested—the gas came from the Silvertown works of The Gaslight and Coke Company.

Mr. COURTNEY: What leads you to say that it was not tested?

Witness: I live in the district, and I know that there is no official tester. It is not tested for the West Ham Local Board nor for the Metropolitan Board of Works.

Mr. CRIPPS: I am informed, I am not sure how it will turn out, that the gas comes from a part of the Chartered district which is not within the metropolitan area, and, therefore, which is not under the ordinary provisions which the rest of the Chartered gas is under.

The CHAIRMAN: Perhaps it would be well for you to give some evidence upon that point by-and-by, as we have identified the place now.

Mr. PHILBRICK: I can give you evidence upon it.

Examination continued: One of the cards upon which I experimented was a large one, which had been exposed in the shop for six months, and I found as much as 1·8—*i.e.*, nearly 2 grains of sulphuric acid upon the whole surface of it, which was about 3 square feet. I calculated the quantity of sulphur that would be deposited as sulphuric acid upon a square foot of surface, and I found that the tenth of a grain would have been deposited from 1000 cubic feet. I obtained a smaller card from another shop, and estimated the acidity upon it, and found it exactly the same, calculating for the same amount of surface as the larger one. I also calculated the acid which was deposited upon the top of an iron box, which had been exposed for some time in another place. I sponged the surface of the top, which was about one square foot, and I estimated the acidity in the liquid. I found the total acid was nearly equal to 2 grains of sulphuric acid. I have further suspended moistened bibulous paper in a room, and have found that two-tenths of a grain of sulphuric acid was deposited on a square foot from 100 cubic feet of gas consumed. I suspended some moistened linen and some moistened flannel in the same room, and obtained precisely the same results. I tried ventilating the room through a hole in the wall, close to the ceiling, so as to create an outward draught, and hung moistened paper in front of the opening, when I found that the sulphuric acid increased very considerably. In all these experiments I know of no other source from which the sulphuric acid could be derived except from the gas which was burning there. There was no coal fire burning—nothing but the gas. I have had my attention called to books that have been on the upper shelves of a large library; and I have noticed that they have been abraded upon the surface, and that they are all distinctly acid—very acid—not merely *distinctly* acid, but *very* acid; and I have noticed also that the ridges of the books which project take up more acid than the other parts of the books. I observed it still more with Morocco leather or Russia leather than with ordinary leather. The injury that is complained of is the rotting of the leather of the edges of the covers of a book, so that when the book is opened they crack and break off. The Morocco and Russia leather appear to suffer more, probably on account of the openness of the grain, which absorbs more readily. I sponged the backs of eight volumes—eight octavo volumes, I think they were—and I found a total of two grains of sulphuric acid, of which 1·4—that is, rather less than a grain and a half—was in a free state as free sulphuric acid. Not all the leather, only a part of it had been abraded—the roughened part, that is the edges, was very acid, and is still very acid, although it has been sponged five or six times—a sponge drawn over the surface, not allowed to remain on the book; and that acid is still due to sulphuric acid, and not to any other acid. I have noticed that dust collected in places where much gas is burnt is very hygroscopic; and, moreover, when it is washed and dried it presents all the appearances of charred organic matter—it looks as much like powdered charcoal as anything—in fact, it presents all the appearance of organic matter having been subjected to the action of strong sulphuric acid. I will mention some experiments that I made three years ago, to show that sulphuric acid was formed by combustion of the sulphur in gas, even when the sulphur was there in very large quantity. These are published in the *Analyst* for Oct. 31, 1876. I shall only quote two experiments which I made upon gas which was previously charged with bisulphide of carbon; it was charged by passing the gas over a solution of bisulphide of carbon in olive oil, and the gas was burned very slowly. I think I need not say how the experiment was made; but the result was that the gas showed a degree of sulphur amounting to 444 grains per 100 cubic feet, of which 422, or 95 per cent., had been converted into sulphuric acid. Another experiment was made upon gas containing a still greater amount of bisulphide of carbon; and the total sulphur was 1644 grains per 100 cubic feet, of which 1260, or 76·7 per cent., was converted into sulphuric acid. The object of this experiment was to show that the sulphur compounds are, in fact, converted into sulphuric acid. I may mention that I have collected dust from places where no gas has been burnt, and have invariably found that it was not acid.

Cross-examined by Mr. PHILBRICK: I tested the dust that I last mentioned for the presence of sulphuric acid in precisely the same way that I tested the dust in the room where gas had been burnt. I am not aware of the series of experiments made by Professor Redwood on this point. I cannot call to mind any experiments conducted by chemists of reputation. I supposed that no other chemist had experimented in that direction. For the purpose of determining the quantity of free sulphuric acid present, the absorbent I used was in some cases carbonate of soda, in some cases bicarbonate, and in others caustic soda. It is not necessary that to turn sulphurous into sulphuric acid you must use soda alkalies; there are other things that will do it. If you have sulphurous acid and want to see what quantity of sulphuric acid you can get, it is part of the process to treat it with an alkali; but it is not a part of the process which is designed and adopted for securing the greatest result in the shape of sulphuric acid that the product can yield. I used it to absorb the products of the combustion of the gas. There were no other means of doing it except I used another alkali. You cannot always get sulphuric acid when you have sulphurous acid if you treat it with an alkali. In this experiment I proved that it was not so. An alkali will absorb sulphurous acid, but not convert it into sulphuric acid. It is driven off as sulphurous acid, the sulphuric acid only remaining. It is absorbed by the alkali, and then that which remains is estimated as sulphuric acid. The bed-room hangings from which I extracted the acid were old ones which had been washed five or six times by an ordinary laundress, and starched in the usual way. I have reason to believe that laundresses do use such things as bleaching powder. I did not inquire whether that was the practice of the laundress in question. The shop from which I obtained the show-cards referred to was a druggist's, in which there was a gas-burner in the window, and one or two others inside. One of the cards had an enamelled surface, the other was ordinary cardboard.

Mr. PHILBRICK: Does it occur to your mind that in the preparation of an enamelled card possibly there is a little source of error introduced that ought to be eliminated?

Witness: I know that in this case the enamel on the card was quite neutral; it was not at all acid. I had another card of the same kind sent to me, and that was quite neutral—not at all acid. There was the ordinary stock of a druggist in the shop—sulphur, no doubt.

Mr. PHILBRICK: You must not put it all upon the gas.

Witness: I give you the facts as I observed them.

Mr. PHILBRICK: Do you put it all upon the gas, then?

Witness: Most decidedly.

Cross-examination continued: The gas was supplied to that shop from the West Ham works, which are not within the London limits. I test the gas at Beckton. My results and those made by the company sometimes agree. At one time I had to complain of the way in which they were conducting their tests, as they were constantly bringing their results in opposition to mine. In the calculation I made as to the quantity of sulphur that was in the dust on the top of the cupboard, I reckoned that the same quantity would be deposited in every square foot of vertical space in the room as that which fell upon the horizontal surface. I did not take into calculation the ceiling at all, nor the floor. I only took the four walls. For the purpose of calculation, I estimated that there would be the same quantity of sulphur on every square foot; I do not say that it is

so. As one of the gas testers, I have not formed any idea of what amount of sulphur should be allowed in the gas. In the burning of gas, I have observed a detrimental effect upon things higher up in the room. I attribute that to the sulphuric acid; I do not say that none of it is attributable to the heat, but I know the effect of the acid more than I know of the effect of the heat.

Mr. CRIPPS (in re-examination): I want you just to explain further about this question of the four vertical walls and the cupboard. Why is it that you took the vertical space round the wall as estimating quantity for calculation?

Witness: I took it so as to make it more intelligible to those who were hearing me. I cannot tell at all how much was absorbed by the ceiling. I might have taken the surface of the floor, but it escaped me at the time; and I did not think much sulphur would be deposited on the floor, because that part of the room is better ventilated than the other part, and, moreover, it gets swept and cleaned. My intention was to give the amount of acid, so far as I knew, that was actually deposited on the four walls in the room.

By the COMMITTEE: Was this shop, in which you found the cards, supplied from the same works as the room was in which you made the experiments?

Witness: No; it was the same district, but two different works—one was supplied from the Silvertown works. I cannot say positively whether those works are under restrictions or not.

Mr. CRIPPS: No, they are not; they are some old works which were acquired by the Chartered Company, and when they amalgamated, the company that took them over kept up the same regulations as to that part of the works as the other company had done before; but they do not come under the regulations.

Mr. PHILBRICK: They are under the Gas-Works Clauses Act of 1847.

The CHAIRMAN: You took no means of testing the gas in the ordinary sense, in either of those places, did you?

Witness: No, I did not.

Mr. PHILBRICK: There is one question that I forgot to ask—namely, whether the dust was from the upper part of the room? I rather inferred that; but how high up was the dust?

Witness: It would be about 2 feet from the ceiling, and I should think 7 feet 6 inches or 8 feet from the floor.

Mr. PHILBRICK: The Silvertown works are part of the undertaking which was acquired by The Gaslight and Coke Company, and the manufacture is conducted by them in the same way entirely as for the Metropolis at Beckton—it is part of their general supply.

The CHAIRMAN: What I want to know is, are they subject to the Referees?

Mr. PHILBRICK: No, they are not.

The CHAIRMAN: Therefore, they make gas in any way they please?

Mr. *Matthew Hill Loam*, examined by Mr. CRIPPS.

I have been connected for nearly 26 years with the Nottingham Gaslight and Coke Company. For some time I held the position of resident engineer under Mr. Hawksley, he being engineer-in-chief to the company at that time. The works have now been transferred to the Corporation of Nottingham, and I remain as assistant engineer. The works are very considerable, very large; their area of supply being very nearly 150 square miles. In 1851 the largest daily consumption during the winter was 400,000 cubic feet. Last winter it amounted to four millions and a third. The gas supplied has always been of very high illuminating power, and of good quality. Since the transfer of the undertaking to the corporation, great care has been taken to maintain that quality and purity. The gas is tested in the usual way; the illuminating power is ascertained by a Bunsen photometer. With the old 15-inch Argand burner we get 17½ candles. We have never adopted the London burner yet. During the last six months, the average of the sulphur compounds has been 12·65 grains per 100 cubic feet. We purify chiefly with lime, using the oxide of iron in the catch purifier.

Mr. CRIPPS: Now, using lime, and arriving at that amount of purity by it, how do you manage in removing the foul lime from your purifiers?

Witness: The purifiers are cleaned out as rapidly as possible, and the refuse lime is removed to a place of deposit, and covered over with cold refuse lime, the lime which has been already used, and which has gone cold. The nuisance from the foul lime is really not perceptible; it is not discovered beyond the precincts of the works, or very rarely so indeed. The Nottingham works are within the town; the largest of our works are about two and a half miles from the town, and we have another small works at about a mile and a half from the town.

Is there a considerable population round your works?—Oh, yes; the chief population is within the area of the works.

Can you tell the committee a little how you use this spent lime after it comes out of the purifiers?—The cold lime is simply thrown over the warm lime taken out of the purifiers. That is a simple process, and we have occasionally covered the lime over with tarpauling.

You have not experienced any difficulty?—We have experienced no difficulty whatever. At the Nottingham works we are really surrounded by the largest population, and we have never had a complaint to my knowledge.

What becomes of this refuse lime ultimately?—It is sold to the agriculturists, and some is loaded on railway trucks and taken clean away. It is allowed to cool in the trucks, and it is delivered a great many miles away—some 30, 40, and 50 miles, and so on. The other part is kept until it is sold. Some is removed in carts, by the farmers in the neighbourhood.

I am told that you keep a sort of depôt there, and that the farmers can come with their carts and carry off what they like with their carts?—Yes, that which is not loaded into the railway trucks is put into a place of deposit, and the persons requiring the spent lime cart it away. Even in that way we have no complaint of a nuisance.

Cross-examined by Mr. PHILBRICK: I have been in the neighbourhood of the Crystal Palace. I do not think I should like to establish a depôt for foul lime near the Palace if the works were small. In Nottingham the difficulty has been not so much with the gas as with the sewage. The object of covering the foul lime with tarpauling, or spreading over it some lime which has become innocuous or comparatively so, is to prevent the nuisance of the smell. If we did not take such means we should expect complaints. We carbonize Yorkshire and Derbyshire coal. They are rich in sulphur compounds—one contains more than the other. I have never tested the quantity of sulphur in our crude gas, and cannot give any idea about it. A series of experiments were made some years ago by Dr. Lethbey, Dr. Pole, and others, but I do not remember the results. We are under no restriction in reference to these compounds. We remove them, from our desire to supply a good article. Our gas is better than that of London, and we charge 3s. and 2s. 10d. per 1000. Before the advance in the price of coal we charged 2s. 8d. I have never smelt the foul lime at 200 or 300 yards from our works. We discharge our purifiers about once a day in the winter time.

Re-examined by Mr. CRIPPS: We use lime upon the old plan of purifying, and in that way keep the sulphur down to 12 grains. The lime comes out as carbonate of lime

The CHAIRMAN: You said, as regards the Crystal Palace works, that you thought your plan would not be so well adapted for such small works. What do you mean?

Witness: Of course, if the room is very limited, in changing the purifiers the smell would be discovered much sooner than if you have a larger area to deposit the stuff on in the centre of your works, or in the most remote part; that was what I meant. Of course, every gas company would put the lime where it would be removed farthest away from the public; but if the works are small, of course, it does not give them much option.

There is no doubt, I suppose, according to your view, that as to the Crystal Palace Company, your plan, if adopted, would mitigate very much the nuisance?—I believe it would; I fancy they could do it just equally well as we do.

It is only a question of space, which means expense?—Yes, of course; but I should not think it would mean expense to a very great extent in the neighbourhood of the Crystal Palace.

In working your process, do you find the workmen who have to clean out these purifiers suffer in their hands or eyes?—Not materially; we wash out all the purifiers we can with copious washings, so that ammonia, which is the most offensive to the workmen themselves, is removed as far as we can do so by washing. That is not an expensive process.

Do you know whether it would be equally possible to do it where sulphide of calcium, the result, is produced in the lime—I mean to say, if the means that you take to prevent the inconvenience of the smell were adopted?—Of course, in our method every effort is made to prevent the lime from steaming, and the vapour from passing away beyond the limits of the works; and where the lime is really very moist and steaming to a very great extent, it is covered over with the tarpauling, and with the cold spent lime, and that is the most effectual. That could be applied anywhere.

Does the lime under your process come out of the purifiers in a dry or a wet state?—Not particularly wet, but moist; it would hold together—if you take a handful it would not fall to pieces.

I suppose there would not be considerable increase of expense in applying your process, we will say, to the Crystal Palace works, except so far as it might be necessary to use additional space?—There would not, at all. It is the most ancient process in existence, the purifying process that we adopt.

How far is it from the centre, where you place the lime, to the circumference of your works?—About, I should say, 350 yards from the place of deposit to the road. Purification by oxide of iron is much cheaper than by lime.

Can you give any estimate?—There are a great many estimates, and I hardly know which to rely upon.

How do you store your spent lime, or refuse lime?—We have an enclosure, and when the purifiers are changed the stuff is instantly wheeled there, unless we have an order by rail, and then we put it into the trucks themselves. It is not a covered place, but quite open. Sometimes we have a large stock; we have had as much as 1000 tons.

Would not the covering of the refuse lime with dry earth prevent any smell?—Yes; but the difficulty is, in a place like ours, to get dry earth; and the cold spent lime is equally effective.

Mr. *John Pattinson*, examined by Mr. CRIPPS.

I am an analytical chemist at Newcastle-upon-Tyne, and have been in practice there for about 19 years. During that time I have made frequent examinations of the quality of the gas supplied to the town by the Newcastle-upon-Tyne and Gateshead Gas Company. Since 1869 I have made weekly or bi-weekly tests on behalf of the Town Council, and before that time I made several occasional tests. Those tests included the tests for the amount of sulphur. I have taken the averages out for the last four years. In 1873 the average amount of sulphur in the gas was 7·13 grains per 100 cubic feet; the average for 1874 was 9·4 grains; the average in 1875, 11 grains; and in 1876, 11 grains. The apparatus I used for the purpose of determining the amount of sulphur is that known as "Wright's sulphur test." It consists of a tube about three-quarters of an inch in diameter—a glass tube—which is bent almost at right angles near the middle, and another rod hanging down. In that a small gas-jet is burning, which yields the products of combustion; and for 19 inches of its length it is covered with another tube, and between those two tubes there is water constantly circulating. It is the mode of condensation known as Liebig's condenser. This was the method in use at Newcastle when the Act of Parliament was obtained. Newcastle is one of the places where, by Act Parliament, the amount of sulphur compounds in the gas is limited. The present limit is 17 grains. My testings have been made on behalf of the Town Council, to see whether the Act of Parliament has been properly complied with. There is a slight difference between my testing and the mode of testing adopted by the Referees in London, and I have determined that difference. I have made several comparative simultaneous tests with the Gas Referees' apparatus, employed in the manner described in their Instructions, and with Wright's apparatus, and the difference in the amount of sulphur which they indicate is from one to 1½ grain per 100 cubic feet, the greater being that of the Gas Referees. An average of 7 grains in Newcastle, if it were tested by the London test, would be 8½ grains. The purifying material used at Newcastle during the last 11 years has been almost exclusively lime. Oxide of iron has not been employed excepting, I believe, in one year for a very short time. During the whole of that time no nuisance has been complained of arising from the use of lime purification; the only public complaints which have been made of any nuisance from the works occurred in the years 1869 and 1870. During those years there were very bitter complaints about the nuisance from the works; and there were deputations to the Town Council to ask them to take means to put an end to the nuisance; and at that time I was asked to report upon the source of the nuisance. I examined the works, and found there were several sources. The principal one was from the manufacture of sulphate of ammonia; another, the process of distillation of coal tar; and another, the imperfect and leaky condition of the scrubbers; and the fourth, from waste lime. After my examination the distillation of tar was discontinued. Some time after the scrubbers were put into good order, and the sulphate of ammonia apparatus was very much improved. The consequence has been that there have been no complaints of nuisance from the works since that time. The secretary of the gas company told me, in answer to my inquiries the other day, that he had had no complaints at all for the last two years. If any complaint had been made to the Town Council I should have heard of it undoubtedly, or if any letters had appeared in the newspapers I should have seen them. There are dwelling-houses in the immediate neighbourhood of the works at Newcastle on the east—some three or four rows of houses; there are also houses on the north-east, north, and north-west. The river is on the south, and of course there are no houses there. Within about 300 yards there are houses of a superior description, the rental of which I should think would be from about £30 to £60 or £80 per annum. The lime at the works is dealt with pretty much in the same manner as the last witness described. When the purifier is emptied the foul lime is put into sacks or bags, and carried on men's backs to the depôt outside the works, where it is emptied down, and is immediately covered over with some weathered lime, or old lime which has been oxidized by exposure to the air, to prevent any bad smell coming from it. After lying in that way for some little time it becomes oxidized itself, and the

offensive odour ceases. It is then put into casks and carts, and covered over with a tarpauling of some kind, and in those carts it is removed for about half a mile to a railway siding, where it is put into trucks and sent away to persons who have purchased it—farmers, and so on. I have never heard any complaints of nuisance during that process, which has been going on for a considerable length of time. I believe the use of lime is the best known process for the purpose of purifying gas. There are other processes on trial which may supersede it; but I believe it is the best practical plan. I think that it might be used in London without creating a nuisance. I have made experiments upon the products of the combustion of gas with the view of seeing how far sulphuric acid results from the combustion of sulphur in gas. My opinion is that most of the sulphur is undoubtedly converted into sulphuric acid. When the gas is first burnt I think there is no doubt that most of the sulphur goes off as sulphurous acid; but there is also at the same time some sulphuric acid formed, and I have made experiments to determine that. I burnt a small jet of gas, at the rate of about half a cubic foot per hour, in a Letheby's apparatus—one of the largest sized Letheby's apparatus; and from one-quarter to one-eighth of the sulphur which exists in the gas I found in the form of sulphuric acid. I think that the oppressive feeling felt by many persons in rooms where gas is burnt is due to the presence of sulphuric acid. I am quite aware that the atmosphere of towns contains sulphuric acid and sulphurous acid, and if it were possible to free them from those sulphur compounds I think it ought to be done. There is no practical means of doing that at present, but there are practical means of getting rid of the sulphur in the gas, and that ought to be done, even if it were carried to the point of absolute purity, if possible. It is well known that plants will not thrive in a gas-lighted room, if they are kept there. I attribute that to the sulphurous acid and the conversion of it into sulphuric acid. I think, from my experience, that it is far better the public should pay an increased price than consume impure gas. The whole expense of the purification by lime at Newcastle is only about two-thirds of a penny per 1000 cubic feet, and if twice that amount of cost were incurred, I think none of the consumers would object to it.

Cross-examined by Mr. PHILBRICK: The two-thirds of a penny applies to the cost of purification at Newcastle. I do not know what it may be in London; but supposing it were twice, or even five times as much, it is worth undergoing that expense to get rid of the sulphur. Wright's apparatus, which is employed at Newcastle, gives higher results than that of Dr. Letheby. The difference I found between Letheby's apparatus and Wright's varies from 1·18 grain to 3·57 grains per 100 feet. I do not know why Wright's apparatus was discarded and Letheby's adopted, but it was decidedly a mistake, because Wright's not only gives higher results in sulphur, but is more easy and simple to work. Letheby's apparatus has now been practically superseded in London by the Gas Referees. At Newcastle nearly half the alkali works in the kingdom are established. The alkali does not neutralize the sulphuric acid; I am sorry to say it has the opposite effect. Flowers under glass flourish very well at Newcastle, but on the Tyne, four or five miles below, damage has been done even to flowers under glass from the alkali works. They formerly used Townley Main coal at the gas-works there, but there is none used now. That coal contains very little sulphur. The coal now used comes from the Durham district. I do not know the quantity of sulphur compounds in the crude gas. They do not purify at all in the way suggested by Mr. Patterson. They scrub their gas very considerably, and it is owing to that, I believe, that it is so free from sulphur compounds. The gas is treated with gas liquor, and afterwards with lime. Sometimes the sulphur has jumped up considerably, and I have always found on those occasions that something has been wrong with the scrubbing arrangements—the pumps have gone wrong, or something out of order. The lime from their purifiers comes in the shape of carbonate of lime, and also sulphide of calcium. I can scarcely say whether they distil their gas at a high temperature; they get about 10,000 feet per ton. I think more bisulphide of carbon is produced when the distillation is carried on at the higher temperature, but I have no experiments upon that point. The highest amount of sulphur impurity I have found in the Newcastle gas is 30 grains, and the lowest about 4·5 grains. For some weeks, with several consecutive tests, I have found 4·5 grains extending sometimes over a period of six months. I believe Mr. Livesey, of the South Metropolitan Company, has tried scrubbing with gas liquor for the removal of the sulphur compounds, but I do not know the process, and cannot speak about it. I am not aware that he has failed in his endeavours to do so. The principal action of the scrubber is to take out the carbonic acid and not the bisulphide of carbon. The latter might have some affinity for the ammonia. The foul lime from the purifiers at Newcastle is covered over with a quantity of weathered lime, which, by the process of oxidation, gets rid of the smell. The lime retains the sulphur until it is converted into sulphurous acid; the action of the air then converts that into sulphuric acid without evolving the sulphuretted hydrogen.

Re-examined by Mr. CRIPPS: When I have asked the cause of a sudden rise in the quantity of sulphur in the Newcastle gas, the explanation has very often been, that there was something wrong with the scrubbers. This leads me to think that there is a great connexion between the operation of scrubbing and the presence of the sulphur compounds.

By the COMMITTEE: I have several times been present at the opening of the purifiers. I have not observed that the workmen employed on those occasions have suffered from the operation. If they ever have to complain of their eyes being affected, I should think that would arise from the iron purifying, not the lime; from the evolution of ammonia. I attribute the stuffy or offensive feeling experienced in a room lighted with gas to the evolution of sulphurous acid, and the large quantity of carbonic acid which is also present. I believe it is injurious, but, perhaps, not appreciably injurious, to a healthy person; to a delicate person I think it would do harm. I have never seen the works of the Crystal Palace District Gas Company.

Mr. *Stephen Smith*, examined by Mr. CRIPPS.

I am a member of the firm of Stephen Smith and Sons, who carry on business at 35, King Street, Covent Garden, as silversmiths. For some time past we have been annoyed by what we believe to be injury to silver from the gas burning. It is an observable thing to any one connected with our trade, the moment one enters into it. We find that the labour required to keep our stock in order during the summer months, when we do not burn much gas, is very much less than in the winter months when we do; it would probably be about half during the summer months. In our trade a very considerable expense is incurred in order to carry off the fumes of burning gas by proper ventilation. I may mention that I rebuilt the premises I am in about seven years since, and I went to a very great expense buying sun burners, and providing other artificial ventilation in the roof, for the express purpose. We formerly took stock as we could, and for two or three years the labour in cleaning the stock has been so severe, from its being exposed to the gas for about three hours at night, that last October we adopted the system of taking stock in early morning with most satisfactory results, and the difference was something very extraordinary. On those occasions the whole of the stock has to be exposed—it is not even kept in the glass cases, but it is all put out to be identified, and of course it gets the worst effect it can from the bad atmosphere. I find that silver goods which have been exposed to the fumes of gas burning for some time have a sulphurous smell about them. That would hardly be the case with goods kept in glass cases, but speaking of factory goods, which we are not so particular about the exposure of, where they might perhaps be for a month or six weeks lying in a place uncovered, it is exceedingly strong and most offensive; and with regard to the surface, my foreman has called my attention to the fact that it seems to bite into the surface, so that it has almost to be removed again by polish. My father was partner with Messrs. Elkington originally, and I was consulted in the original scheme of opening their London establishments, and for some years after we opened it nothing but oil lamps were used for that reason. Then I may say that these rooms ten years since were very much enlarged, and it was impossible to carry on that system, and we were obliged to give it up, and now we have gas as other people do. It is the case, however, that in some two or three of the old-fashoned style of shops, lamps are still used for that purpose, despite all the cost of them, to avoid the sulphur.

Cross-examined by Mr. PHILBRICK: Having regard to the injury done to goods in our trade, I should avoid exposure to the gas. There is nothing I caution my customers so much against as allowing their servants, after plate has been used, to leave it exposed all night. The result of that will be that the sulphur of the gas will settle down upon it, and the most extremely bad results arise. I do not represent to the committee, that the gas in London injures plated goods more than the gas in Liverpool, or Manchester, or other large towns. The constant remark that I hear from Glasgow houses is that it is worse than it is in London. The expense in my establighment is £150 or £200 a year merely for cleaning, and that kind of thing, beyond what it would be if we could get a pure atmosphere. I do not say it is all owing to the gas. I am not attending to business so closely as I did, and therefore I cannot answer the question, whether the matter has got worse rather than better, but I have not heard our people speak of it. Where gas is burnt there is always more labour in cleaning plate in winter time than in summer. The sulphurous smell I spoke of is only on the metal surfaces of goods in the workshops. I am not aware that other surfaces are affected by it. I do not know what else it can arise from than the gas.

Re-examined by Mr. CRIPPS: This is considered so much a matter of course, that if you asked even a porter who has been employed in the silver trade what it is that tarnishes the silver, he will tell you it is the gas.

Mr. *James Slater*, examined by Mr. O'HARA.

I am a partner in the firm of Holland, Son, and Slater, carrying on business at No. 16, Jewin Crescent, as manufacturing silversmiths. When I was first in business I did not burn gas. As my business increased, and buyers came in late in the evening, I was obliged to take to it, but though I took to it, I did it very unwillingly, and used it with very great distaste to myself. I found the evil effects of it, even in fine weather, upon my goods. Those effects were most seriously aggravated in foggy weather; gas and fog combined, I think, are the two evils that we have to contend with in London. In less than half an hour after the gas has been lighted, the goods in the upper part of the room in glass cases, near the ceiling, suffer the soonest; but to me it only seems to be a question of time and the size of the room. You have only to get on a pair of steps immediately the gas is lighted, and put your head up to the ceiling, and you feel the heat. After the gas has been lighted a little longer you need not go so near the ceiling to feel the effects from the gas. If you have goods on a table, at the level of that at which we are now sitting, they will be affected. You may say, "Then why not ventilate your room?" That is another weak point in London; people do not ventilate their rooms. I keep fires sufficiently large to keep the whole place thoroughly warm, which is of the highest importance with a stock like mine. I tried gas for the purpose, and had to abandon it in less than a month, for though I obtained heat, the smell was excessively unpleasant.

Cross-examined by Mr. PHILBRICK: I know it is, as a matter of general opinion, that the atmosphere of London and other large towns always contains a portion of sulphuric acid, and I am perfectly aware of the injurious effects produced by exposing plated goods to it.

The CHAIRMAN: Was the injury that you described, as occurring in rooms where you did burn gas, a kind of injury that would arise from the action of sulphuric acid upon plated silver?

Witness: Without being a chemist or a scientific person, I say decidedly so; and if the committee will permit me, I will give a very striking illustration of the difficulty I had to contend with. In my early career, when I objected to the use of gas, I had the misfortune to have some cases wrapped in a peculiar kind of paper. The goods got perfectly black. I had the paper tested, and it was coloured by some mercurial process. I had it removed and plain paper furnished, and my goods were kept with very great satisfaction. Then I introduced gas into the place, and in a smaller degree I had precisely the same results that I had had with the mercurial paper. I am not attempting to go into the question whether mercury and sulphuric acid have the same effects, but I am speaking of a practical result—that, upon the introduction of gas, my goods, if exposed to the action of gas, become tarnished in the same way, and the effect of this matter was so insidious, that instead of its being able to be removed quickly, it took the men some considerable labour. Our goods are polished—that is, polished by a man with rouge on the ball of his hand, and he had to do that. That I suffered from most.

And you attribute that to the effect of the gas, do you?—I make no doubt of it.

Do you desire that it should be purified of this sulphurous element?—I certainly do; and I am very much interested in gas operations. I am very sorry that there should be any depreciation in the quality of the gas, because when a fog comes on suddenly, there is a very short supply, and there is very great difficulty in getting adequate light. In my own house I would not have gas if it were given to me.

But you are not analyst enough yourself to say to what element in the gas this was due?—No; I should be sorry to say anything but what comes under my own practical experience.

The CHAIRMAN (to Mr. Cripps): Have you any other witness to call?

Mr. CRIPPS: I have no more evidence of this class to put before you. There is one other witness upon a different matter. Of course, there comes a time when we must take the responsibility of adapting our evidence. I only wish to guard myself to this extent by saying that I must not be taken to have exhausted the evidence on behalf of the Metropolitan Board and the Corporation. I may have to call further evidence in another case.

The CHAIRMAN: Do not understand me as wishing to stop any evidence that you may have to give.

Mr. CRIPPS: Quite so, sir; but one has to exercise a certain amount of discretion in this matter.

Mr. *Samuel Edwards*, examined by Mr. CRIPPS.

I am clerk to the Lewisham District Board of Works. That district is supplied by the Crystal Palace Gas Company to a great extent, and also by the Phœnix. Two-thirds of the inhabitants of the Crystal Palace district, I think, are within the Metropolis. I am generally familiar with the district. Within the Metropolis there are 1096 public lamps

lighted by the Crystal Palace Company, and 516 beyond. The former are in Lewisham, Penge, Lambeth, and Camberwell. I know the works of the company very well; they are about a mile from the Palace. The Lewisham District Board of Works are the sanitary authority of the district, and also the authority for the execution of the Nuisances Removal Act. There has been no complaint of nuisance or annoyance at these works from the use of lime, except on one occasion, when the case was investigated, and it was shown——

Mr. PHILBRICK: Do not tell us what was shown.

The CHAIRMAN: How was it shown?

Witness: It was shown by an investigation by the Board of Works. I was not present. It was information that was given to me.

Mr. PHILBRICK: This gentleman, sir, is an officer of the Board who lays informations and takes out summonses against the companies. I rather object to a witness of that class giving evidence of this kind. I would rather he should confine himself to what he knows.

Mr. CRIPPS: The Lewisham Board of Works are the sanitary authority, and he would know of any complaint made to them, and I am asking with reference to that so far as within the Metropolis, of course. (To witness:) You say there was a complaint made some time ago?

Witness: There was a complaint of the river being polluted.

Not a complaint from the use of the lime of the gas-works or the lime purification?—Well, it was incidentally so.

That is to say, the river was polluted by this purified lime being put into it, or carried near it, or something of that kind?—I can explain the exact circumstances. The explanation which was given to me as clerk of the Board of Works, and upon which I decided that no proceedings should be taken against the company, was this—that the lime had been removed and put into a pit in a brickfield some mile from the works, and that, in consequence of a very heavy rain, this pit had overflowed, and carried the liquid into the river, and the injury that was done thereby was of very short duration. I thought it was a pure accident, and therefore no proceedings were taken. That was the only complaint of the use of lime.

You, as representing the sanitary authority, would know the feeling of the inhabitants generally. Are you aware whether the proposal now before this committee is altogether unsatisfactory to the inhabitants there, and undesirable?—I believe it is, and much objected to by the Board for which I act. They object to what is proposed to be done by the Bill before the committee.

The CHAIRMAN: Have you heard no complaint as to the smell when the purifiers have been cleansed?

Witness: No, none whatever.

Have you observed that smell yourself?—No, I have not; the railway goes into the works in close proximity to the purifiers, and, if there was a nuisance, of course it would be complained of.

I suppose you have never been present when the purifiers have been cleaned, have you?—No, I have not, and practically all the adjacent houses are on one side, the north, south, and east sides are open fields.

It is becoming an increasing neighbourhood, is it not?—It has been increased very much within the last 20 years, and is increasing, but it is flat land, north, south, and east. It is in the valley very near the river, and in a very ineligible place for building. I live three or four miles off, but I am in the neighbourhood very frequently, and in constant communication with the residents. The works are at Bell Green, and very near the Lower Sydenham Station. There are no houses, within a mile of these works, which are not shown upon the plan produced.

Do you happen to know whether the land about there is very expensive, if it was desirable for the company to acquire additional ground?—I should think it was the least expensive ground in that district, from its being flat, and also from the proximity of the works.

You cannot give an estimate of what it is per acre, can you?—No; the land has been recently purchased by the company in extension of their works. The works are about 1000 feet long and 500 feet wide. The purifiers are about 500 or 600 feet from any habitation, and those are the residences of the men employed at the works.

Mr. PHILBRICK, in replying upon the whole case, said: Sir, as my learned friend, Mr. Cripps, on the part of the Metropolitan Board of Works, has concluded his case, the matter is now ripe for the decision of the committee, so far as the evidence is concerned. In the discharge of the duty that I owe to my clients, I must make a few remarks to the committee upon some of the evidence; but I trust that I shall not unduly trench upon your time. Let me first of all call your attention very briefly to the position in which we are as a company. We are a suburban company in a district which has just been pointed out to you, which is becoming rapidly built upon—which is built upon with property of an exceedingly good character—a villa, and a residential, neighbourhood, in the suburbs of London. We are manufacturing our gas, not under the restrictions of the Metropolitan Acts at all; we have been deliberately excluded more than once (and in spite of an attempt of the Metropolitan Board of Works to include us within their net) from the category of metropolitan companies; and I think I may say, I trust not unfairly, on the part of those whom I represent, that there is not the slightest reproach that can be cast upon this company, either in the way in which they conduct the manufacture of their gas, or the way in which they treat their customers or the public at large. We are here with a directory composed of gentlemen of scientific eminence who manage their concerns with a due regard certainly to the interests of the public; and I do put it to you very strongly that the company have claims on the consideration of Parliament when it is shown to you that with the capital we had it in our power to raise at 10 per cent., we raised £50,000 at only half of that rate. When we came to Parliament again and obtained leave to raise new capital at 7 per cent. (the rate that is now allowed for gas companies on new capital) not one shilling of that capital has been raised, except as absolutely called for by the requirements of the district, and to enable us to supply the gas which we are bound to supply in our district. We have kept down the price of gas to private consumers outside the Metropolis, and in a district where our mains are necessarily long, and not as productive as in a more densely-populated neighbourhood, at the rate of 3s. 11d. I say under these circumstances the company do come with something like a fair case, I do not say for favour, but for the consideration of Parliament, in asking to have the restriction, which they feel to be an oppressive restriction, removed. My learned friend, Mr. Cripps, on behalf of his clients, as to whose opposition I have not one word to say, states that the Metropolitan Board constitute themselves, or are constituted, the guardians of the public interests. They do not seem to have very many of the public in this district, or any one who takes sufficient care or pains about the matter, to come forward here and say, "We object to that which the gas company are proposing to do." They do not bring forward here a single consumer who says, "We think this restriction ought to be kept, and ought not to be removed, because we would rather have the increased purity of the gas and have these sulphur compounds taken out, than have the restriction removed with a corresponding benefit in the shape of a reduction of price accorded to us." But my learned friend says, "Here was a statutory bargain come to between Parliament and the company in 1873; you then had power to raise your capital at 7 per cent., and you had the restriction put upon you of the 20 grains of sulphur." I was very much obliged to one of my learned friend's witnesses yesterday who gave us a history of the matter, I think it was Mr. Heisch, who was in a little difficulty as to the exact time when the restriction came into force. The Act of 1860 had prescribed a certain quantity as a hard and fast line. The Act of 1868 put it upon the Referees to prescribe other conditions that we have all heard of in this room. The Referees did not immediately proceed to discharge their duty in that respect; they awaited the result of certain investigations; and the result of their experience was stated in answer to a question of the chairman, that at the end of 1872, or the beginning of 1873, the present limits, or the limits that were first prescribed, were laid down. Now that is a most important date for me, because in November of 1872 we had given a parliamentary notice for a Bill, which became the Act of 1873. We were before Parliament in the session of 1873, and Mr. George Wilson Stevenson, whom we called before you, was examined before the committee in that year. The regulations of the Gas Referees had just come out, and he, advising as he was the Metropolitan Board of Works, said, in answer to the question, "Don't you think that there ought to be some test for purity?" "Yes, I think it quite right." "What?" said Mr. Horace Lloyd; "ought it to be 20 grains?" That was what he had in his mind; 20 grains was what the Referees had prescribed. That was the first amount settled when they came to discharge their duty under the Act of 1869, and therefore most naturally Mr. Stevenson answered 20 grains; and so, without a single word of comment, without chaffering, I may say, it was accepted at once and put into the Bill, in clause 17, which we seek to alter. So far from that being a bargain, I venture to say this: If it was a question of a bargain it was an unfair bargain, and we come with good grace to Parliament to be relieved from it; but it was nothing of the kind. It really was a restriction put upon us without due consideration at the time, without a thorough appreciation of what the practical working would be, or the difficulties that it would entail, and therefore we come here, finding what the results are, to have it removed. Now, sir, let me be, as I feel sure I can be, in doing ample justice to the case of my clients—let me be candid with the committee about this. We have had here to-day some evidence that has struck me, and I am sure it must have struck the committee, as being remarkable. We have had a gentleman from Nottingham who tells us of the results. We have had a gentleman from Newcastle who tells us of results that they obtained there, and as to those results, the question arises in a moment, why cannot you do it in London? The answer is, I think, conclusive—because the conditions are different. In the first place, you have at Newcastle, and also at Nottingham, an entire choice of coal, and you have a different coal to carbonize. It may be said we could get the same coal in London; it is a question of money only. The answer is that practically we cannot, and what has Parliament thought was the right thing to do with reference to the Metropolis? Not to lay down a hard and fast line in the matter of these impurities, but to enact that it shall be left to a tribunal—the Gas Referees—composed of gentlemen practically conversant with the subject, from time to time to ascertain with what degree of purity the companies can reasonably be required to make and supply gas continuously without occasioning a nuisance to the neighbourhood; and the Referees do prescribe the maximum amount of impurity that should be suffered to remain in the gas. Now, what have the Referees done? They have said, if you manufacture your gas within a crowded area, on account of the nuisance, injury, or the risk of injury which must inevitably be entailed by the process of lime purification, we will allow you to have a greater amount of sulphur compounds than if you manufacture gas out of the limits of the Metropolis, where the use of lime would not be so objectionable. And I say that what the Referees have done under that Act was a matter that might fairly enough warrant this company in coming to Parliament. But in our case we have a hard and fast line of 20 grains. We supply a district where the houses are not those of a poor class—not an artizan district or a populous neighbourhood, but houses of a superior and villa description, and we are put under a hard and fast line, which is the most rigid line of any company in the kingdom that I have heard of, except Newcastle, and far harder and worse for us than the limits of the metropolitan companies. I say that alone would make a justifiable case for our coming to Parliament. I have called your attention to the particular circumstances of this company, as their local position, and the exceedingly hard limit which is put upon us on this question, places us in a worse position than any of the great London companies. The Commercial Company, who are, perhaps, under exceptional circumstances, are working at 30 grains, which is 50 per cent. more than we are. I dare say it may be altered, but we know that in the winter 25 grains are allowed to an urban manufactory. But I turn to the evidence called on behalf of the Metropolitan Board themselves, and I cannot appeal on that matter to higher authority than to their own consulting chemist, Mr. Keates. And what did he tell us? He said, "I am myself rather in favour of relaxing the limit. I think a little above 20 grains may be allowed, but I think it would be the greatest possible mistake to remove the restriction altogether." And then he is asked: "How much would you give them?" and he says, "I think even 25 or 30 grains might be allowed." I dare say no honourable gentleman could have sat upon a committee without noticing the various phases with which witnesses come forward. Sometimes we have witnesses that will not answer; sometimes we have a witness that wants to talk a little too much; sometimes we have one who is jocular; but here is an answer, not from a person who has come to give a hasty opinion, and from whom an unguarded one is extracted on cross-examination, but a gentleman who is put forward by the Metropolitan Board themselves—their own chemist. My learned friend, Mr. Cripps, with his great experience in these committee-rooms, never asked Mr. Keates a single word as to the expediency of these sulphur tests as applied to this company, but left it; and if it had not been that this question was put accidentally by me to Mr. Keates, one never would have known his real opinion upon the matter. Therefore, the evidence comes before you very strongly indeed; first, from the fact that my learned friends were not instructed to bring it out, or did not bring it out; and, secondly, because they knew that in that way, from his being candid enough, as you might expect from a gentleman in his position, and sound enough, I may say, to say, "I think it may be relaxed." I think he said, "When you consider the expediency between a nuisance created and an advantage to be gained, I think 30 grains may be allowed." I do feel a difficulty in this case on another matter, where, upon a question not of absolute truth and verity, but upon a question of degree, Mr. Keates puts it to us as a matter of expediency. He says in one case a nuisance could be created, and possibly on the other an advantage might be gained. No doubt. I never sought to conceal from the committee that having gas absolutely pure would be a great advantage; to have it relatively pure would be also advantageous. It is a question as to what degree of purity can fairly be got. Now, what have we to see to? We have had here to day a number of gentlemen absolute purists in matters of gas, and who think that all gas burning is injurious. I dare say it is. I dare say it destroys the plated surface of silver, more or less, but gas burning, after all, is a necessity; and because of the particular refinement of the silversmith's trade, gas cannot be put out either in public thoroughfares, or in shops and warehouses. I pass that by at once, and I say that that class of evidence can satisfy you of nothing when the question

is how much impurity is it right should be allowed to remain; and how much of it the Legislature ought imperatively to exclude? Therefore, I should ask you, when you come to consider it, to look at the quantities of the impurity, and the effect that they have shown to have been produced. We have had here the whole opposition of the Metropolitan Board of Works. It is a singular fact, but it is a fact not without its significance, that they have not brought before the committee a single experiment, or set of experiments, which affect to show the result of combustion of the ordinary gas unpurified from the other sulphur compounds. They have refrained, or, at least, they have not been able, to bring before you any results of the condensation of gas which contained, as Dr. Odling's and Mr. Russell's experiments did, 33 grains of this sulphur compound in 100 cubic feet, but they content themselves with bringing to your notice the evidence that has been referred to the committee by order of the House—namely, the evidence given before the committee of 1866 or 1867. They have referred to that, and they have called before you one or two chemists, and they have—well, I was going to say, produced before you a portmanteau, which Mr. Heisch very prudently withdrew. We have not had proved a complaint on the part of a consumer in the Crystal Palace district, nor of a consumer of gas at all, except that of a gentleman who says: "I would not use gas at all, pure or impure; it affects my wires." You have not, I say, a single complaint of any consumer, with regard to gas. True, it is said that brasswork is injured; but, apart from the sad instance of two or three crystals of copper found on the bell-wires in Dr. Frankland's house at Lancaster Gate, I have not heard of any brasswork actually injured. Some one of the witnesses said that there was not so much injury on the floor, that the bright places on the grates and stoves were not injured—I think it was Dr. Frankland who said so—or not so much injured. I pressed him, and he said there was no injury in that part of the room. Well, I asked, in the upper part of the room, where the picture rods and wires were; was there much upon them? I could not make out from him that there was any definite or tangible amount, nor could I make out that the heated zone, in a badly-ventilated room, where gas was burnt, or, indeed, where oil was burnt, was due to sulphur or sulphur compounds. It is said that you have sulphurous acid gas. I agree you have sulphurous acid gas at the point of combustion, but you have no sulphuric acid at all. We were told by Dr. Frankland that the greater the ventilation the better the condition of the room, and the more likely was it that a minute quantity of sulphuric acid would be produced at once, but if you have the condition of ventilation, with sulphuric acid produced, you have that condition in a minute degree, but rapidly carried off; whereas if you have a hermetically sealed hot box in which these products are placed, you have a condition which prevents that combination, and therefore you have sulphuric acid. Then it is said, as long as it is hot it is all very well, but afterwards, when cooling takes place, there occurs condensation and precipitation. If there is precipitation, one would suppose that on the articles in the lower portion of the room you would find the effects of that precipitation; that it would fall down, and that that which had been in suspense in the heated atmosphere above would descend and make its effect apparent on all that was in the room below. But do we find that? I venture to say that the whole of that portion of the evidence is speculative, assumptive, theoretical, and not practical and reliable. And then, when we come again to the statements of Professor Barff, who gave his evidence with singular candour and fairness, he told us undoubtedly that sulphuric acid, even diluted, will affect ultramarine with certain zinc pigments in it, and if it continue long enough, it will destroy the fabric and fibre of the hemp canvas itself. Agreed, but does it practically do so? It is said these compounds do the mischief. I answer by pointing to Dr. Oldling and Mr. Russell, whose figures, and theories even, have not been combated; those experiments have been untouched by any of these gentlemen, and not in any degree controverted. None of the witnesses say that these sulphur compounds have any influence upon the health of healthy persons. I think one of them did say it might occasion distress and suffering in the bronchial tubes, or in breathing to an invalid; but the answer was clear, first of all, that the quantity which was respired was the quantity which was in the middle zone of the atmosphere which Dr. Odling described to you, and was very minute in it; it is not what is in the zone next above that an invalid would be subject to in the least. These conditions are not generally found, but are conditions when gas which is charged with these compounds is burnt, all the products of combustion most carefully condensed and saved for the purpose of giving you, not what actually occurred, but what could by any possibility occur in the worst condition of things that could possibly exist. Now, sir, I say, in the face of that, that there is nothing beyond the merest speculative opinion upon the part of these gentlemen that these sulphur compounds really do cause detriment. The conditions of burning in a laboratory for the purpose of chemical results are far in excess of anything that is really effected in the ordinary method of combustion. When it is said that these impurities are very objectionable indeed, producing the stuffiness of the rooms and the atmosphere, and so on, the answer is that a good deal of carbonic acid is necessarily evolved during the progress of combustion. That must be so whatever your gas contains, and the nausea and headache are the consequences. I think one of the witnesses said it would possibly account for these results. The answer, I think, is that there is abundantly sufficient to account for it in the presence of carbonic acid, and the matters that have been referred to, without putting it down to sulphur. I will not weary the committee upon this any longer, except to make one concluding remark. We have heard a good deal about the outcry against sulphur. It is supposed to be the parent of all these evils. I say deliberately, after having heard all that has been stated, that there has not been traced home to these other sulphur compounds any one of these evils. If they do exist, they can possibly be assigned to other causes. It has not been proved that they arise from the sulphur. Then let me ask where is the harm of allowing this company to manufacture their gas in the way they propose to do? It is not supposed for a moment that they are going to force sulphur compounds upon the public from any desire on their part. They admit them to be objectionable. They would be glad to get rid of them, but they object to be under this restriction as to the use of lime in their neighbourhood. It is not a question of cost. If it were a question of cost in removing the lime merely, I should not be here to ask you to remove the restriction; but we submit that the best test of the difficulty of working is one of the elements in it. One of the witnesses said there was no annoyance to the men who discharged the purifiers, but he was speaking of the time when the old lime process was in use, and not of the state in which these horrible products are employed to absorb the sulphur compounds, in order to carry out the system of the Referees. Mr. Livesey told us that though the men had masks on, and he had practically tried all kinds of things, the men did complain bitterly of it. I do not wish to make too much of that, yet it is one of the matters attending the manufacture of gas under the condition in which we are. I venture to say that no case has been made out why we should be dealt with in a worse way than the metropolitan companies, and I say that the evidence which has been given on the part of the Metropolitan Board has shown that 30 grains might be conceded to us, or half as much again as we have now. But I am asking you to remove this restriction altogether, not, as I say, that we would import a single impurity into our gas, but that we may carry out to perfection our own purification by the peroxide process, and not be driven to the necessity of having the lime in the condition that we have to use it. It is said that there is no great nuisance to the neighbourhood; but then we have to work always under the fear of penalties, with the knowledge that a nuisance may arise at any moment, beyond our control. We have to work always to the standard, and whereas under the more favourable conditions of the London companies, who are allowed a three days average, we are on a hard and fast line of a single day, and may be sued by the Lewisham Board if we transgress by only half a day. We have also the knowledge that tests are not particularly accurate, even though there is great experience used in making them. We have the fact further, that these sulphur compounds themselves are not proscribed in any of the cases in which the Board of Trade grant Provisional Orders. They are not proscribed in any case in which corporations carry on gas-works throughout the kingdom. They are not proscribed in Paris, where works of art are considered, and as highly thought of, as they are here, and where our neighbours are as particular as we are. I venture to submit that upon the whole of this case the only solid and definite ground under your feet to go upon is that found in the actual results of the experiments made by Dr. Odling, by Mr. Russell and Mr. Stevenson, and that those results show how utterly unfounded is the cry that has been taken up, "*Omne ignotum pro terribili est.*" They did not know what it was, and therefore they were afraid of it. The moment you test it you see the result, and find that there is nothing in the presence of these few occasional grains of sulphur compounds, the presence of which can fairly be said to be the source of these evils. It is not a question of trying to get rid of them altogether; no one pretends that it is the question of adapting any one of these processes suggested, none of which have been carried into operation, but it is a question of reducing from one-fifteenth to one-tenth the total quantity of these. I venture to say that the company have made out their case, and even upon the evidence that has been given I respectfully ask the committee to declare the preamble proved.

The committee-room was then ordered to be cleared, and the committee consulted. After some time the counsel and parties were called in, and

The Chairman stated that the committee had decided that the preamble of the Bill was not proved.

Wednesday, May 9.

THE GASLIGHT AND COKE COMPANY BILL.

Mr. Pope, Q.C., Mr. Richards, Q.C., and Mr. Michael appeared for the promoters; Sir E. Beckett, Q.C., Mr. Cripps, Q.C., and Mr. O'Hara for the Metropolitan Board of Works and the Corporation of the City of London, petitioners against the Bill. The Board of Trade were represented by Mr. Round.

Mr. Pope, in opening the case for the promoters, said there was a very grave distinction between the case of The Gaslight and Coke Company and that of any smaller concern in the country, where, whatever might be the regulations prescribed, either by Act of Parliament or by the action of the Gas Referees, the processes could be so much more easily dealt with, and the results of those processes disposed of with so much greater facility. When it was recollected that The Gaslight and Coke Company represented, in fact, the gas supplied to very nearly three-quarters of the Metropolis, it was obvious that the questions involved affected not only great interests on the part of the company, but equally large interests upon the part of the consumers; and it was matter for rejoicing that the whole question would be thoroughly sifted by the gentlemen who were interested upon the part of the public, and who would take care that the whole matter was investigated so far as might be necessary for arriving at a decision. Originally the Chartered Company was one of thirteen companies supplying the Metropolis with gas; but, in pursuance of powers conferred upon them by Parliament, they had gradually absorbed most of the companies north of the Thames, and thus constituted one large undertaking. The gas companies which were merged in the Chartered Gas Company were the Imperial—which was the latest amalgamation, in 1875—the Independent, the Western, the Equitable, the Victoria Docks, the Great Central, the City of London, and some other smaller ones. The Gaslight and Coke Company manufactured gas at ten stations, but there were, of course, other stations which were not manufacturing, and others which had been abandoned. As the committee were aware, the Chartered Company some years ago extended their works to Beckton for the express purpose of carrying a large proportion of their manufacture as far as possible out of town. The largest manufacturing station, therefore, was at Beckton, and the gas manufactured there was conveyed by mains passing through the Commercial Company's district. The actual acreage which the company had at Beckton was about 150 acres, of which some 70 or 80 acres were covered with buildings, and the remainder of the unoccupied land there was used for the deposit of the foul lime which was the result of the purifying process at their various stations. Passing towards the west from Beckton, The Gaslight and Coke Company had another manufacturing station in the immediate centre of the Commercial Company's district, which they did not, of course, supply; and passing still further west they had the station at St. Pancras. Both Shoreditch and St. Pancras were formerly stations belonging to the Imperial Company, and the committee would find, with reference to those stations, that, having changed hands since 1875, the same processes which were resulting in difficulties with them were still resulting in difficulties with the Chartered Company. There was also a manufacturing station at Lupus Street, Pimlico, on the margin of the river, close to the neighbourhood of St. George's Square—a neighbourhood of which the committee would hear a good deal in the course of the case. The stations in London of The Gaslight and Coke Company's district were a manufacturing station at Fulham, and a large station at the extreme west at Kensal Green. The committee had already been made acquainted, in the course of the inquiry which had taken place, that the insisting upon a certain amount of purity from sulphur compounds was practically insisting upon purification by lime; and the two questions which arose as regarded the public and as regarded the nuisance, were simply, first, as to the nuisance arising from the process in the neighbourhood where it was carried on; and, second, what was to be done with the enormous mass of refuse which was the result of that process. The latter point, it would be seen at once, in the case of The Gaslight and Coke Company, immediately assumed an importance (simply by reason of the size of the operations carried on) which it did not assume in the case of a small company where they were dealing with a comparatively small manufacture of gas, and had only a limited amount of refuse to dispose of. In the present case, when the committee were told that the amount of refuse lime deposited by The Gaslight and Coke Company covered an area of ten acres of land to a depth of nine feet every year, it became a very serious question, what was to be done with it, if purification by lime was insisted upon as a statutory matter. At Kensal Green—the extreme west, and with no immediate access to the river—they did the best they could in disposing of their lime upon the spot; but with that exception, all the spent lime had to be conveyed either by river direct, or partly by canal and river, to Beckton, where it was spread upon vacant land, Beckton being out of the reach of those who complained of the nuisance; but it would be for the committee to consider whether,

dealing with a question of that magnitude, that disposition of refuse could go on for long, because, unless some means other than the use of lime could be discovered or suggested for the purification of gas from the sulphur compounds, the day must come, and at no distant date, when there would be no means for the disposition of that refuse lime, unless it were taken into an estuary of the sea, and thrown into the water, when they would doubtless have Hastings, St. Leonards, Margate, Ramsgate, and all the watering-places, coming to Parliament and complaining of the enormous nuisance deposited by the tide upon their beaches. That being the exact state of facts as regarded the manufacture, he (Mr. Pope) would point out what the position of The Gaslight and Coke Company was. The committee would find that, whether during the course of transit or during the process of emptying the purifiers, from the neighbourhood surrounding those works, constant and most serious complaints were made of the nuisance which was created at Shoreditch, at St. George's Square, at Fulham, and all round the districts where the works were surrounded by habitations; not only sentimental complaints, but complaints which had culminated in threatened indictments, and in a real public nuisance to those who surrounded the works. Upon that point evidence would be called as to what the real matter was; and the committee would doubtless be satisfied that whatever nuisance was occasioned, by the use of the lime system of purifying, was inevitable in the use of that system; but every possible suggestion which could be offered in order to minimize the nuisance was adopted, and the greatest possible care was taken to prevent it from being a nuisance to the neighbourhood. It could be well understood that, although the passing of a load of spent lime simply caused a smell which was obnoxious for an instant, and which did not seem to be a serious nuisance, yet it would be found that the result of personal experience upon all hands was, that those who made light of it at first very soon came to regard it with respect; because, although at first the smell was slight, and the nuisance not very intolerable, the result of it in the disturbance of the bodily economy was very considerable indeed; and that was exactly the description of the state of matters, notwithstanding all the precautions that could be taken, where the stations were surrounded, or were in the centre of great populations. By the City of London Gas Act, 1868, Gas Referees were appointed for the first time, and provisions made with regard to their powers of testing the illuminating power and purity. The 29th section was as follows:—"The Board of Trade shall, as soon as may be after the passing of this Act, appoint three competent and impartial persons, one at least of them having practical knowledge and experience in the manufacture and supply of gas, who shall be called the Gas Referees (and who are in this Act referred to as the Gas Referees) and in case of a vacancy happening among them by death, resignation, or otherwise, shall appoint a competent and impartial person to fill the vacancy, one at least of the three being always qualified as aforesaid." It was obvious that the Legislature in 1868 felt that the circumstances involved in testing for purity, and in the regulations made for securing the purity of gas, were of so special a character, that one at least of those who were to have any control over the matter, and in whose discretion a great power was placed, must be in point of fact a practical gas manufacturer, who would be acquainted with the difficulties of dealing with the question as a matter of practical manufacture, not as a matter of laboratory chemistry; and the worst that could be said of the tribunal seemed to be, that it was difficult to secure, under the provisions of that section, the competency and impartiality united which were so desirable, because if they had a gas manufacturer, he, generally speaking, must be connected with one of the companies, and could hardly be called impartial, although he was competent; but, on the other hand, the section itself seemed to indicate that if they had a chemist who might be perfectly impartial, not being connected with gas manufacture, he could hardly be reckoned as competent. The main source of difficulty, therefore, arose, not from any want of knowledge theoretically upon the part of the Referees, but upon the difficulty of associating with theoretical knowledge the peculiar competency which was recognized by the section, and which competency of itself necessarily gave a certain bias and want of impartiality. He (Mr. Pope) would at that point say, once and for all, that although probably it might be necessary to criticize what the Referees had done, he should do so in a spirit not only of the greatest respect, but of the most sincere acknowledgment of the honour and knowledge which they brought to bear upon the subject, and it was simply because that tribunal was found to be unworkable from the very nature of its constitution, and the powers which were committed to it, that the inconvenience was found to arise for which a remedy was now sought. By the 36th section it was enacted that "The Gas Referees shall from time to time ascertain with what degree of purity the said company can reasonably be required to make and supply gas continuously without occasioning a nuisance to the neighbourhood in which the works are situate, and shall thereupon prescribe and certify the maximum amount of impurity in each respect with which gas supplied by the company shall be allowed to be charged, and the time from which the allowance thereof shall be enforced as against each company, regard being had to the necessity for any alteration of works by a company consequent on any such certificate." Taking that section in connexion with the provision as to the competency and impartiality of the Gas Referees, it would seem to be as elastic and as favourable to the gas companies as possible, but the experience of the few years which had elapsed had shown that, although it appeared to be elastic, it was, in fact, so arbitrary and so inconvenient that there was no resource left to the companies excepting to ask the interference of Parliament for its modification. The first Referee who was appointed was a gentleman who had been connected with the manufacture of gas, and who on all hands was admitted to be a gentleman of the highest competency, and certainly having practical knowledge and experience in the manufacture and supply of gas, and with him were associated two other gentlemen. Finding the extreme difficulty of prescribing the amount of sulphur compounds, so long as the Referees had the advantage of a practical acquaintance with the supply of gas, they declined to prescribe any specific amount of impurity, but declared that the companies must keep a register of the amount of sulphur impurity, in order that the matter might be fully and freely investigated, both as to its result on the consumers, and its possibilities with regard to the companies. Mr. Evans subsequently resigned, and his two colleagues, Mr. Patterson and Mr. Pierce, having become connected with some large coal supply, were not re-appointed on the termination of their year of office.

The COMMITTEE: The only impurity we are asked to consider is the impurity of the sulphur compounds?

Mr. POPE said quite so. There was no complaint whatever about the sulphuretted hydrogen or any impurities about which regulations were made. Mr. Evans resigned because it was felt by those representing the consumers that they could not regard him as impartial, he being a gas engineer, and that really showed the unworkability of the section.

Mr. O'HARA: Was he not the engineer to the Chartered Company, and not a gas engineer merely?

Mr. POPE said that was the case. The present Referees were Mr. Vernon Harcourt, Dr. Pole, and Professor Tyndall. Without saying more as to what their powers were the result was that they had prescribed that in the gas made at Beckton, Bow, and Bromley, the maximum amount of sulphur allowed should be 15 grains per 100 cubic feet; for gas made at the other works of The Gaslight and Coke Company, and for the works of the South Metropolitan Gas Company it should be 20 gains, and for the gas made at the works of the Commercial it should be 30 grains. Those regulations were to be enforced from March 31, 1877, until superseded by future notification. It was, however, only right to mention that that was a notification for the summer part of the year, the previous notifications which would bear upon the winter not being quite so severe, because they allowed a further margin of 5 grains, being 20 grains to Beckton, Bow, and Bromley, and 25 to the other works of The Gaslight and Coke Company. The plan adopted by the Referees from 1868 to 1872 was as follows, adopting their own words:—"The gas shall be considered to be impure, rendering the company which issues it liable to the penalties prescribed in the Act, when it contains more than 5 grains of ammonia in each 100 feet, or when it shows the least trace of sulphuretted hydrogen. The quantity of sulphur compounds other than sulphuretted hydrogen shall, until further order, simply be recorded."

The CHAIRMAN: Was that system of fixing a certain number of grains adopted in 1872?

Mr. POPE said it was, and was continued up to the present time—at first not so strictly as now, but for the last two or three years it might be taken that practically the notification he had given the committee had prevailed and was prevailing at present, of 20 and 25 grains.

The COMMITTEE: During the period when these things were simply recorded, were there occasional remonstrances, regarding the sulphur compounds, addressed to the company?

Mr. POPE said at that time the lime process was not used, and there were none of the complaints as to the nuisance. According to the present condition of things it was perfectly plain that, to comply with the decision of the Referees, purification by lime was absolutely essential. The company were between two fires—they were threatened with indictments for their purification, and with penalties for non-compliance with the Referees; and, although it was perfectly true that in 1876 the penalty provisions were relaxed, in a sense, making them penalties on an average amount, and not on any particular delinquency on any particular day, still they were subject to penalties on the one hand, and indictments on the other, and it was a difficulty from which they very naturally desired extrication. Dealing with the question of what Parliament intended with regard to this matter, he (Mr. Pope) would ask the committee to refer to the Act of 1871, which amended the Gas-Works Clauses Act of 1847.

The CHAIRMAN: Is the penalty under the 74th section of the Act of 1868 £50 a day?

Mr. POPE: Yes, sir.

Mr. O'HARA: That is all changed now.

Mr. POPE said it was only changed in the sense he had mentioned. It was £50 a day, but instead of being a penalty, as it was in 1868, for every day, it was modified by section 51 of The Gaslight and Coke Company's Act of 1876:—"If on an average of three days the gas supplied by the company from any station is of less purity than it ought to be under this Act, the company shall forfeit a sum of £50 for each station in respect of which they are so in default;" so that instead of being a penalty of £50 a day for one day, they had taken an average of three days, with one penalty of £50, and then another three days would be another penalty of £50.

The COMMITTEE: It might come to the same thing in the way of penalties. Monday, Tuesday, and Wednesday are three days, and Tuesday, Wednesday, and Thursday are another three days.

Mr. POPE said he hardly thought they could inflict penalties in that way, because it would not be another three days. If the committee turned to the Gas-Works Clauses Act of 1871, at section 12 they would find all the provisions which in 1871 were thought necessary to be made with regard to the question of purity:—"The quality of the gas supplied by the undertakers shall with respect to its illuminating power be such as to produce at the testing-place provided in conformity with this Act a light equal in intensity to that produced by the prescribed number of sperm candles of six in the pound, and such gas shall as to its purity not exhibit any trace of sulphuretted hydrogen when tested in accordance with the rules prescribed in that behalf in Part II. of the Schedule A to this Act annexed." In other words, in 1871, for companies not under the jurisdiction of the Gas Referees, no provision was made for any sulphur compound except sulphuretted hydrogen; and of course all gas-works which were regulated by the Gas-Works Clauses Act had no provision with regard to sulphur impurity, and it was unnecessary for them to incur any of the disagreeable alternatives which the action of the Gas Referees had placed upon his clients. Passing to the Chartered Gas Act of 1876, the committee would see that from section 27 onwards there were re-enacted, subject to the modifications of section 51, the penalties to which attention had been previously called, and which were as binding upon the company as the other provisions of the Act of 1868. Section 30 re-enacted exactly the provisions of the 36th section of the Act of 1868 already quoted, subject to the modification by section 51, the penalty being calculated upon an average of three days, instead of under section 74 of the Act of 1868. This was the position of the company at present, and he (Mr. Pope) would briefly state what they asked the committee to do. The company found themselves between two fires. They found, whatever might be the appearance of elasticity about these clauses, that they were, in fact, arbitrary and unworkable, and, therefore, the Bill before the committee asked that those powers and those provisions might be entirely repealed. It was quite possible they might come to the conclusion that some restriction, at all events upon sulphur impurity, was desirable; but if that were so the company contended that it would be entirely within the province of the committee, while not repealing those provisions, so as to leave the company absolutely and entirely free from restriction, as they would be if they were not under the Gas Referees at all, so to relax those provisions as to introduce as an instruction or a control upon the Referees, fixing a minimum amount, beyond which their discretion should not pass, and which would, in the words of the Act of Parliament, render it possible to maintain a "reasonable amount of purity," without causing a nuisance to the public. The words of the statute were: "That the company is to be required to furnish gas with such an amount of purity as they can reasonably be required to make, and supply continuously without occasioning a nuisance"—words very large, words very wide, words which seemed to indicate that Parliament had at that time in its mind the very difficulty which had arisen, and from which the company were unable to escape, and as to which there was no use throwing off to the future the discussion of a question which, after all, had better be discussed at that time. The company therefore asked to be taken out of the jurisdiction of the Gas Referees as regarded sulphur impurities, though not as regards any other sort of impurity. If the committee doubted the prudence of that, at all events they might grant relief by putting such a minimum as would prevent the company being reduced to the uncomfortable position in which they found themselves, and from which they asked equitable relief from a committee of Parliament.

The CHAIRMAN: Was this clause objected to when you sought your Bill last year?

Mr. POPE: I think not; I have made inquiries, and I think there was no fight upon the Bill of 1876.

Mr. O'HARA: I may say that when the clauses in the Bill were settled it was a matter of convenience to them, and the three days average was the only thing the company struggled for; the degree of purity was not objected to, but it was said to be a hardship that the impurities of any one day should be taken as a test, and therefore it was agreed that the average of three days should be substituted. The action of the Referees was not objected to, only the mode of enforcing the penalty.

Mr. POPE said no doubt that was so; but the real truth was that The Gaslight and Coke Company's Act of 1876 was passed before the result of the amalgamation with the Imperial Company had really been ascertained. At that time the Chartered Company were removing their manufacture to Beckton for the purpose of getting rid of the particular difficulties which would cluster round their works, but on their amalgamation with the Imperial Company they also acquired the *damnosa heritas* of that company. As had been already pointed out, the Shoreditch, the Haggerston, and the Fulham stations were all legacies brought to the Chartered Company by the Imperial, and it had really only been since they had become amalgamated that the difficulty had arisen of carrying on that process in manufacturing stations surrounded by dense populations.

The CHAIRMAN: I wish to know whether any of the directors who obtained this Act in 1876 had had experience before that of the control of the Referees?

Mr. POPE: No doubt the Chartered Company were always under the control of the Referees.

The CHAIRMAN: I mean to say including the Chartered Company, because they had their works at Beckton, and they did not suffer so much.

Mr. POPE: What you wish to know is, whether it was the Imperial directors or the amalgamated directors. Mr. Phillips tells me that they had joined The Gaslight and Coke Company's board immediately before the Act of 1876 was passed.

The CHAIRMAN: Therefore, having had experience of the Referees when they were directors of the Imperial Company, they made no struggle against this clause.

Mr. POPE: That must be accepted as a fact.

Mr. O'HARA: That is the fact, and must be accepted as such; but the way the Act of 1876 came to be passed was this: The matter had been contested hotly in 1875; but the Bill was not proceeded with in consequence of the lateness of the session. The main provisions of the Bill of 1875, settled before Mr. Forster's committee, were re-adjusted by agreement between the Companies and the Metropolitan Board of Works, the Corporation, and the Board of Trade.

The CHAIRMAN: Then there was a discussion about it before Mr. Forster's committee?

Mr. O'HARA: No, the discussion about the average took place upon the settlement of the Bill by consent in 1876.

Mr. POPE: That is as to the average of three days, but what the chairman was asking about was, whether this old purity question was before Mr. Forster's committee.

Mr. O'HARA: Undoubtedly it was fully discussed there.

Mr. POPE: The legislation of 1876 was practically based upon the decision of the committee of 1875.

The CHAIRMAN: It was thoroughly discussed there.

Mr. O'HARA: Yes, it was threshed out.

Mr. POPE: No, hardly threshed out; it was discussed.

The following evidence was then called:—

Mr. *Frederick John Evans*, examined by Mr. MICHAEL.

I am a civil engineer, and a member of the Institution of Civil Engineers. I have been connected with The Gaslight and Coke Company for more than forty years, and for many years had the management of the Goswell Road and Westminster stations. When I retired from the company's service I was the chief engineer. I am well acquainted with their system of purification. I designed and constructed the Beckton Gas-Works, which are the largest in the world. They were constructed under the powers obtained by the company in 1868. I was selected by the Duke of Richmond, who was then the President of the Board of Trade, as one of the three Gas Referees to be appointed under the Act, on account of being practically skilled in the manufacture and distribution of gas. I held that appointment for eighteen months, but ultimately resigned, in consequence of being repeatedly attacked by the Metropolitan Board of Works, and by the Corporation of London, for not fixing the standard of purity as far as sulphur was concerned, and they used to make some very severe remarks, saying that I was prejudiced in favour of my own company. At last it became so unbearable that I sent in my resignation to the Board of Trade, but they declined to accept it. They said, "We will write to the Corporation, and very likely you will not be annoyed in this way." However, the annoyance went on, and I resigned again, but the Board of Trade still declined to accept my resignation, because they were so well satisfied with the way in which I performed my duties. Eventually, things became so bad that I insisted upon their accepting it, which they did in May, 1871, and sent me a very complimentary letter, regretting the cause of my having to resign. I was at that time the only member of the Board of Referees who had any practical acquaintance with gas manufacture. In 1872 I resigned my position as engineer-in-chief to the gas company. I was then elected to a seat on the board. There was a special clause in the company's Act of 1872, empowering me to be appointed as a director. The directors themselves had no power to appoint a director, as the board was filled up, but by that special clause I was appointed to act as a director, and I have so acted since. Since that time I have taken an active part in the affairs of the company, in the engineering and manufacturing departments. In the early period of gas manufacture lime was used for purification. The lime was mixed with water, put into a wet lime purifier, and the gas was allowed to bubble through the lime water, and this purified the gas from the carbonic acid and the sulphuretted hydrogen. The refuse water was at that early time—I am talking of 40 years ago—run into the sewers, and it got into the river, or we used to run it into the ground—in fact, we got rid of it as best we could. However, a stop was eventually put to that, and I think it was in the year 1825 that the complaints became so numerous that the Secretary of State of that date, I do not know who he was, appointed Sir William Congreve to investigate the gas company's works, and he found that this refuse lime—"blue billy," as it was termed then—was causing the nuisance, and he gave instructions, and recommended to the Secretary of State, that the whole of the works should be puddled round outside, which was done, but it effected very little good. After the gas had been passed through the milk of lime there were no other means adopted for purification. At that day we knew nothing about sulphur, and all we considered necessary was, that if the gas was free from sulphuretted hydrogen, it was practically free from any impurity. I believe at that time the presence of sulphur was very little known. I have a book here—Matthews's "History of Gas Lighting"—in which the presence of sulphide of carbon is distinctly denied by Dr. Dalton, and by John Thomas Cooper, the great gas chemist of that day. This was given in evidence before Parliament on the Westminster Oil Gas Bill in 1825. The chemists of that day did not believe in bisulphide of carbon, and said it did not exist. We said, "As long as the gas is free from sulphuretted hydrogen, it is quite good enough," and the public thought so too. Carbonic acid was not considered an impurity, but we took it out because we could not help it; if it took out the sulphuretted hydrogen we must take out the carbonic acid. After a time the company adopted another process; they allowed the "blue billy" to settle in the tanks, the solid matter fell to the bottom, and the thin liquid was evaporated under the ash-pits. The thick stuff was then burned in ovens, and used over again for purifying. The nuisance became so great that we, about 1840, adopted the dry lime process, which consisted simply in passing gas through a vessel containing lime in a sort of moist state—slack lime, in fact. This lime is placed upon trays, and the gas goes through it. The same amount of impurity is taken out—carbonic acid and sulphuretted hydrogen. A difficulty soon occurred, and that was the immense trouble we had with the refuse lime. When I say that it took double the quantity to purify the same amount of gas with the dry lime process that it did with the wet, it will be seen that the quantity of lime we had to dispose of was very great indeed. Each ton of coal takes about a bushel of lime, or about 60lbs. There are 18 bushels to a cubic yard or ton, and a yard of lime when it is slaked produces two yards of slaked lime. We tried every plan we could think of. We used to ventilate it—that is to say, before the lime was taken out of the purifiers we used to drive atmospheric air down through the lime, and it went up a chimney. That was carried on some time, but the evil was not lessened, because it simply drove out the sulphuretted hydrogen from the lime. It went up the chimney and fell down in the neighbourhood, and a curious thing was—I am now talking about the Westminster station—that it used generally to fall down in Dean's Yard, and we used to have complaints from Dr. Buckland and other residents there. The Chartered Company were at that time indicted for a nuisance by the parish authorities. We used to convey the lime away in covered carts, but the informers used to follow the carts, and lay hold of them, and take them to the greenyard, and the contractors were taken before the magistrates and fined; but, independently of that, there was a great difficulty in getting rid of that refuse lime. An immense quantity of it was deposited in Belgravia; in all the roads and the fillings-in there are thousands and thousands of cubic yards which have been shot there; but at last that was shut against us, as Mr. Cubitt said, "I cannot have any more of this filth here." Then it was taken away into the country, and we had to pay as much as £1 a yard to cart it away, and what the end of it would have been I do not know—we must have shut up our works, I am afraid; but about the year 1840 we discovered that peroxide of iron, or hydrated peroxide of iron, could be used for purifying gas, and that it could be used over and over again without any nuisance whatever; no sulphuretted hydrogen was given off on exposure to the air. The sulphur that had been absorbed by the iron was thrown out again on exposure to the air, and was left in the material as pure sulphur. This material could perhaps be used for twelve months, and at the end of that time the material was sold at a profit, and we had no further trouble at all until within the last few years. It acted also in this way, that the sulphur kept continuously increasing in the purifying material until it became worth the while of manufacturers to extract it for the purpose of making sulphuric acid. We were in consequence enabled absolutely to sell it at a gain, and then have the material brought back again after the sulphur had been taken out. That method, which entirely superseded the use of lime as a purifier, continued in use up to the appointment of the Referees in 1868. The question of the sulphur in gas arose during the proceedings on the Act of 1860; but previous to that the attention of the public had been drawn to it by the late Dr. Letheby in 1854 or in 1852, I do not know which. He exhibited before the Court of Sewers a little bottle containing oil of vitriol, saying he had obtained it from the combustion of 100 feet of gas burning in a room. The Court of Sewers were astonished at it, the papers got hold of it, and it was shown that this destructive compound would very soon, as he stated, destroy not only the atmosphere, but destroy life, destroy furniture, and in fact would destroy everything. At that time there was a denial in the scientific world as to the bad effects of sulphur in gas, and also as to the production of sulphuric acid. I should, however, tell you that when Dr. Letheby and other people at that time were condemning the gas companies for making such impure gas and destroying everything—when he got these 21 grains of oil of vitriol in 100 feet of gas—that that 20 grains only represented 7 grains of sulphur, which shows how little he knew of it; and yet when the Act of 1860 was passed, it was only by Dr. Letheby showing that, the 20 grains of sulphur, which really represent 60 grains of oil of vitriol, was inserted. In the Act of 1860 there was no prescribed mode of ascertaining the quantity of sulphur in the gas, nor was there any apparatus defined; but there were heavy penalties for non-compliance with the Act, I think amounting to £20 a day.

Mr. MICHAEL: You will find that the 25th section of the Act of 1860 is, "The quality of common gas supplied by any gas company shall be, with respect to its illuminating power at a distance, as near as may be, of 1000 yards from the works, such as to produce from an Argand burner, having 15 holes and a 7-inch chimney, consuming five cubic feet of gas an hour, a light equal in intensity to the light produced by not less than 12 sperm candles of six to the pound, each burning 120 grains an hour; and the quality of cannel gas supplied by any gas company shall, with respect to its illuminating power at the distance aforesaid, be such as to produce from a bat's-wing or fishtail burner, consuming five feet of gas per hour, a light equal in intensity to 20 such sperm candles; and each such gas shall, with respect to its purity, be so far free from ammonia and sulphuretted hydrogen that it shall not discolour either turmeric paper or paper imbued with acetate or carbonate of lead, when those tests are exposed to a current of gas issuing for one minute under a pressure of five-tenths of an inch of water, and shall not contain more than 20 grains of sulphur in any form in 100 cubic feet of gas: Provided that any gas company, and the local authorities of the district supplied by such company, shall be at liberty to agree upon any other or different test by which to ascertain the purity of the gas, or to vary the amounts of ammonia or sulphur in any form hereinbefore allowed, and thereupon the company shall be thenceforth liable to have the purity of their gas tested in the manner so prescribed." Then comes the 26th section, which prescribes the penalties: "If the gas supplied by the gas company be at any time of less illuminating power or of less purity than according to this Act it ought to be, the gas company shall for every such offence, on a summary conviction before a police magistrate, forfeit a sum not exceeding £50, and also, in addition to that penalty, and whether that penalty be recovered or not, a further sum of £10 for every day after notice in writing from the local authority during which the offence continues: Provided that such police magistrate shall not convict under this section, if it shall be proved to his satisfaction that such defect of gas was occasioned by any unavoidable cause or accident." Now those [pointing to a model] are little bits of bibulous paper wetted with acetate of lead in order to determine whether or not sulphuretted hydrogen is present in the gas.

Witness: Yes. We ordinarily employ such apparatus, which is continuously in action, in order to show day by day whether sulphuretted hydrogen has been present in the gas or not. If it is present, it causes the bibulous paper so wetted to become brown or black. We keep a register

of those pieces of paper every day; but a similar apparatus is used at the testing-places by the testing chemists.

The CHAIRMAN: Are we concerned with this part of the case—sulphuretted hydrogen?

Mr. MICHAEL: Only as it bears upon the question of the sulphur. I think we may take it generally that all the metropolitan gas is absolutely free from sulphuretted hydrogen. I do not think any question will arise upon that.

Examination resumed: The provisions of the Act of 1860 were never carried into effect at all. There was never a case in which a company—although they were constantly infringing the amount of 20 grains—were convicted.

Mr. MICHAEL: In fact, was anything whatever done by the gas companies to diminish the quantity of sulphur which was left in the gas after it had been purified by the oxide of iron?

Witness: I think not; as far as my own company were concerned, that was so.

Have you any means of knowing how the quantity of 20 grains in the Act of 1860 was arrived at?—That was done by an apparatus called Dr. Letheby's apparatus. It consisted in burning the gas in a trumpet tube, and the products of combustion were condensed in a glass cylinder; instead of an upright thing, it went into a cylinder like that [pointing to a model], and the products of combustion with the water that was formed fell to the bottom. Those products were afterwards taken away and operated upon, and the amount of sulphur contained in the gas was ascertained.

Have you been able subsequently to determine whether or no the apparatus that was then devised really gave an accurate representation of the quantity of sulphur contained in the gas?—No; it did not. The difference of Dr. Letheby's apparatus and that apparatus was equal to about 8 grains in 20—that is, 20 grains would be made into 28 grains by that apparatus.

It was not the fact, therefore, that the cylinder was diminished in size in order to prove a smaller quantity of sulphur, but in reality to prove a larger amount of sulphur?—Yes.

It was not that a larger cylinder gave a larger quantity of sulphur than ought to be represented, but in truth it gave a smaller quantity than the actual quantity present?—Yes.

By the use of that cylinder you get a more accurate representation of the total quantity of sulphur, other than sulphuretted hydrogen, contained in the gas?—Yes. I may say that the Referees, when they first fitted up the testing-stations, had a large cylinder, but the result obtained was not to be depended upon at all; they then put a small cylinder, about four inches in diameter, and that gave a better result, but the amount was so uncertain that the thing was not to be relied upon at all; and then we contrived the apparatus which has been used ever since. I do not say that that gives the full amount; but at any rate there is more uniformity in its results, and it gives a very fair average; and one thing in its favour is that it is so easily worked, that it requires no skill, labour, or special talents.

The CHAIRMAN: Perhaps I might interrupt you for a moment, but I do not know what this evidence is leading up to.

Mr. MICHAEL: This is giving you the history of legislation with respect to sulphur, and to show under what circumstances the limit of 20 grains was fixed.

The CHAIRMAN: Is your contention that 20 grains ascertained by the old process is more than 20 grains under the modern one?

Mr. MICHAEL: 20 grains under the old process really represented 27 grains, if correctly determined; the quantity ought to be according to the experiments, not put at 20 grains, but at 27 or 28 grains.

Witness: It also shows this, that the public, while they were thinking they were only burning 20 grains, were really burning 28 grains, and made no complaint.

Therefore, we may fairly assume, if the apparatus had been as perfect then as it is now, that 27 or 28 grains would have been put in the Act instead of 20 grains?—Yes, I think so.

The CHAIRMAN: You say, in fact, that it was 27; your contention is that practically it was 27 grains?

Mr. MICHAEL: Only, having that error, it was put in at 20 grains, when it was intended to be 27 or 28 grains.

The CHAIRMAN: That does not follow.

Mr. MICHAEL: I can only put the case in the best way possible. When we have to go back 17 years it is very difficult to define what was in the minds of the committee or the Legislature.

The COMMITTEE: It is not a question of "mind," is it? Your contention is that the Act prescribed a limit of 20 grains, according to the apparatus then used, while the new apparatus limited it to 27 grains.

Mr. MICHAEL: Quite so. (To witness:) Dr. Letheby gave evidence very frequently with respect to the sulphur question in gas Bills, did he not?

Witness: Yes; he was the great authority.

Mr. MICHAEL: Did he not constantly say there were no known means of eliminating the sulphur from the gas?

Mr. O'HARA: You must produce that if Dr. Letheby said so. If you have any treatise of Dr. Letheby's you may produce it, but do not give your views of what Dr. Letheby said.

Witness: You have the notes of his evidence there.

Mr. O'HARA: Then my learned friend can use them, but I do not want your remarks on that.

Examination resumed: In 1868 the sulphur question came before Parliament again, but the committee felt there was not sufficient information for them to determine, or for them to fix an amount of sulphur, and they thought the best plan would be to appoint three gentlemen as Referees, who were to investigate the question, and they were then to determine what the amount should be, carrying out that clause in the Act which says that they are to act with all due regard to a nuisance not being created. Practically it comes to this, that there was no fixed limit put in the Act of 1868. I was one of those Referees, and there were two other gentlemen appointed, who were not specially acquainted with the process of gas manufacture. The Referees investigated the various modes with reference to the sulphur question. Our first endeavour was to devise means for testing the illuminating power of the gas; and that apparatus is now in use. My colleagues were Mr. R. H. Patterson and Mr. Pierce. We investigated the question of the sulphur, and I showed them all the experiments, and also what our duties were, and how the sulphur could be taken out. When they applied to me to know whether I could not fix a standard, I said, "No, I cannot, if I conscientiously carry out that Act of Parliament. I am not in a position to determine any amount of sulphur. There is only one mode of reducing the amount of sulphur, and that is by the use of lime." I then told them that that always created a nuisance, I showed them the lime, and everything else, and said I could not recommend a thing which I knew would be a nuisance to the neighbourhood, and a nuisance to the public generally.

Mr. MICHAEL: What did that eventuate in on the part of the Referees—what was the plan you adopted?

Witness: There was nothing done during all the time that I was a Referee. I never could fix the maximum amount of sulphur; the other Referees felt with me that it would be a very great hardship upon the companies to fix a standard, having regard to that clause in the Act of Parliament.

I think you recorded the amount of sulphur?—We did; we gave orders that the amount of sulphur, as tested by this apparatus, should be simply recorded; the object of that was to see whether the amount of sulphur in the gas was uniform, or whether it went up and down with fits and starts. In fact, we wished to see exactly what took place under this new state of things. I left after 18 months, for the reasons I have given, and I think the Referees themselves, after I had left, were till 1872 before they fixed the standard. When I resigned, Dr. Pole, one of the present Referees, was appointed in my place. In 1872 the places of Mr. Patterson and Mr. Pierce were filled by Professor Tyndall and Mr. Vernon Harcourt. Those gentlemen had a knowledge as chemists, but I do not think they had a practical knowledge of the manufacture of gas. I do not think, if they had known all the circumstances of the gas companies at the present time, they would have fixed 15 or even 25 grains. We made some very extensive and expensive experiments upon a plan originated by Mr. Harcourt, costing upwards of £1500, but up to the present time no practical mode has been devised, without the use of lime, by which the amount of sulphur in gas may be limited. The Referees decreased the maximum amount of sulphur to be allowed, so far as Bow, Bromley, and Beckton were concerned, which obliged us to use an increased quantity of lime. Up to that time we had in some cases used lime in conjunction with oxide of iron, to take out the carbonic acid. From that combined process no nuisance resulted, but owing to the more stringent regulations of the Referees we were obliged to increase the quantity of lime used for the purpose of reducing the sulphur compounds, the result being that we brought down the amount of sulphur to the requirements of the Referees. There was no difficulty; I knew all along that lime would do it, but I always objected to the use of lime, on account of the nuisance it occasioned, and not only the nuisance, but the difficulty of getting rid of the refuse lime. The use of oxide of iron was, therefore, discontinued altogether, and lime substituted in its place, which is a retrograde movement altogether—it is a reflection upon science. We were actually in 1875 going back to the old time of 40 or 50 years ago, when the directors at that time saw the nuisance and ceased to use it; they abandoned it, and now we are compelled to go back to it again.

The COMMITTEE: The two processes are combined, are they not; you use both?

Witness: We should, if we were allowed to go back to the oxide of iron again, use a little for the carbonic acid.

Mr. MICHAEL: I do not think you have quite apprehended the honourable member's question; do you at the present time use oxide of iron with lime?

Witness: No; we are obliged to give up altogether the use of oxide of iron, and revert to the process of lime simply, in consequence of the restrictions put upon us by the Referees.

But before that you had used the combined process of oxide of iron as a purifying medium, with a small quantity of lime, which, as I understand you, created no nuisance, in order to get rid of the carbonic acid, which deteriorated the illuminating power of the gas?—Yes.

I also believe there are some injurious effects, which are hardly well ascertained to be due to the excess of carbon in the gas burnt?—I do not know anything about that.

Did you make any representations to the Referees, asking them to reconsider the determination at which they had arrived with respect to the amount of sulphur?—Yes, we did repeatedly; and in the result the Referees said, "We think you can do it; we think you are not using sufficient care, and we shall not alter our maximum."

Do they inspect your various stations?—Yes.

Have they ever pointed out to you any processes which you might adopt, and which you have refused to adopt?—No; we have adopted everything they have suggested.

Has it eventuated in this, that in adopting this process, and reverting to the use of lime, you are constantly told that you are creating a nuisance?—That is so.

Will you explain to the committee, as shortly, but as fully, as you can, how that nuisance arises?—The lime, after it has purified the gas, is combined with all the sulphuretted hydrogen, and some of the sulphur compounds, and it forms a sulphide of calcium; that lime, when it is taken out of the purifiers and exposed to the air, or the oxygen in the air, throws off all the sulphuretted hydrogen that has been formerly absorbed by the lime, and it goes into the atmosphere, and causes these complaints. We take every possible care—the purifiers are covered up, the waggons are covered up, the barges are covered up, and still you cannot prevent this emanation of sulphuretted hydrogen. I was on Saturday with Mr. Pope down at Fulham; every care was being taken, but there was no mistake about the smell. I put a bit of acetate of lead paper no my hat; it did not go black, but it got brown, showing the presence of sulphuretted hydrogen.

First, have you used an excess of care, and all means at your disposal, to prevent the production of sulphuretted hydrogen in the air when you have the lime removed from the purifiers?—I believe every possible care is taken by our engineers, but we cannot prevent a nuisance being created. The total quantity of lime in a year we have taken from our various works is about 100,000 cubic yards—about enough to fill up 8 or 9 acres of land 6 feet deep. There is great difficulty in disposing of it; it has all to be taken down to Beckton. There are 150 acres of ground there, but in time all that will be filled up, and where we shall have to go then I do not know. We have been continually threatened with injunctions, and complaints have constantly arisen, owing to the nuisance created by the removal of the lime. There are the Fulham works, about which there have been complaints; and there are the Bromley works, and several other stations where there are great complaints—at Shoreditch and at St. Pancras—in fact, where the lime is used, it is a nuisance, and you cannot get over it.

Supposing oxide of iron, and the small quantity of lime which you represented, were again to be reverted to, would there be such an amount of sulphur left in the gas as to occasion any injury either to life, health, or property?—Certainly not; it is perfectly absurd about that question of sulphur; and before I have done I think I shall be able to show the committee the absurdity of the sulphuric acid question and the whole of the sulphur question altogether. If it were not so serious to the companies, this question of the sulphur in gas would be simply ridiculous, because the quantity is so small that if it was deposited in the way that we have heard stated in this room it would have no injurious effect; but I contend that sulphuric acid could not be formed, and is not formed, and I will show that by experiment. I have practically studied this question, and looked at its effect as gas is ordinarily burnt in rooms.

Have you endeavoured to find out whether any of these alleged disastrous consequences result under any circumstances from the ordinary burning of gas?—It is perfectly ridiculous. That picture [pointing] I have had for 25 years; and, according to the theories we have heard, it ought to have been utterly destroyed by the oil of vitriol. It was hung in my dining-room. It is true the ventilation is very good—there is ventilation into the chimney. That [pointing to another picture] I have not had so long; I have had it eight or nine years. That has been in a hall 16 feet

by 12 feet; but there is a gas-stove in it, and I burn that gas-stove all through the winter; and there is a gaslight as well, but no one would ever say that the painting is injured, or the gilding injured.

Have you ever found these crystals of sulphate of copper and sulphate of zinc deposited from the burning of the gas?—No; it is rubbish; certainly not. We have heard that cordage was affected most tremendously by sulphuric acid. I took a bit of this cord [produced], and wetted it with a little distilled water, and I certainly did expect that there would be an acid action, but it was alkaline. There is the cord there, and anybody may try it if he likes. I should tell you that that picture has been in other rooms under not such good circumstances for 25 years. In that room there were 400,000 cubic feet of gas burnt. According to the theory, supposing you had 30 grains of sulphur in 100 cubic feet of gas, that 30 grains ought to have produced something like 90 grains of oil of vitriol, and during that time I should have had between 15lbs. and 16lbs. of oil of vitriol in the room in which that picture has been hanging. It ought to have been running down, and there ought not to have been a piece of the painting left. The principal nuisance, I believe, derived from gas is from the bad ventilation, nothing else. I will show you again the absurdity of this sulphur question. Take 100 cubic feet of gas, which will produce 75 cubic feet of carbonic acid, it will produce about 200 cubic feet of vapour of water, and about 100 grains of sulphuric acid in the room in which that picture was, which is about 5300 cubic feet capacity. You have a proportion of carbonic acid of 1 in 46. I will assume if all the products of an evening, say of seven hours, are put into the room at once, in that case you would have 1 in 46 of carbonic acid, and 1 in 60,000 of sulphurous acid. Now, sulphurous acid and carbonic acid are equally fatal to life; the one is as much a poison as the other. I have tried it on rats, and things of that sort. If you take carbonic acid and put a rat in it, it goes dead instantly, and the same takes place if he is put into sulphurous acid; so that really the absurdity is this, that you are actually dealing with a thing which only contains 1-60,000th part—that is assuming that there is no ventilation; but if you have good ventilation, it amounts to one part in 5,000,000. You have to deal with that and the carbonic acid, which exists to the extent of 1 in 46. Whoever heard of the explosion of a coal mine taking place, in which the men were killed by sulphurous acid? It is always the carbonic acid which kills them.

There is a large quantity of carbonic acid, no doubt, and there is a great deal of discomfort where there is no ventilation in a room in which gas is burnt?—That is the cause of annoyance.

You have very heated and very dry air?—Yes; and you get an oppressive feeling from the want of oxygen.

I think you have tried an experiment as to turning on the gas and not burning it in a room?—Yes. I gave that evidence in favour of the Metropolitan Board in their Subway Bill; it was a question of ventilation in a subway. I went home one evening from the committee on that Bill about four o'clock, and the gas was alight. I turned off one of the burners and then turned it on again. My wife and other people were there, and they never smelt the gas. They went to bed at half-past ten, and I said, "That is a capital experiment." This burner had been escaping all the time, and they had never smelt it, which shows that all the products of combustion were being taken away, and therefore if any sulphurous acid was formed it was taken away directly. But I go further, and say that sulphuric acid is not, and cannot be, formed. I will show that to you directly.

The COMMITTEE: Is this sulphuric acid formed in any way before combustion takes place?

Witness: No, afterwards.

You say you did not ignite the gas?—That was for a different object—viz., to show the amount of ventilation; it was allowing the pure gas to escape. Of course, it was not burnt. We should have smelt it directly if the ventilation had not been there?

Mr. MICHAEL: At the same time also, if there be any injurious effects from the gas, you have the carbonic acid in the carbon compounds to account for it, and you have the heated and dried air, totally irrespective of the question of sulphur?

Witness: Yes.

I ask you again, have you in the course of your investigations, seen anything to prove that there is any deposit, either of free sulphuric acid or sulphuric acid in compound with metals, deposited from the use of gas?—No. You have got a certain proof. Nothing can be stronger than that picture. It is true you may bring some specimens which have got some damage, but I believe it arises then from other causes.

May I put it to you in this way: If it be good to take away all the sulphur except 15 grains, it would be better to take it away altogether?—That we cannot do.

There are no known means by which the whole of the sulphur could be taken away?—No. You may use lime to any extent, and there is something like 8 or 10 grains of sulphur that you cannot take out.

And if you do, you could not use the gas, as it would not be odorous?—I do not think the odour of unburnt gas is due to any sulphur; it is the natural odour of the hydrocarbon.

I believe the Bill of 1875, which was introduced by the Corporation and the Metropolitan Board of Works jointly, contained no provision whatever as to sulphur?—No, and they were perfectly right—they knew the absurdity of it; they had some eminent chemists to advise them, and they said, "Do not have anything to do with it, it is perfectly absurd;" and they acted upon that advice.

That was a Bill by which it was intended to lodge the supply of gas in those two bodies?—Yes.

Can there be any reason why, if it were requisite to put restrictions on a company, that those restrictions ought not to apply to the Corporation or the Metropolitan Board of Works?—If they thought that the sulphur was a matter of any moment, they were bound to have put the clause in; but they thought it was of no moment whatever.

The COMMITTEE: What was the company you are referring to?

Witness: It was not a company; it was the Corporation and the Metropolitan Board of Works. They brought in a Bill to make their own gas.

Mr. MICHAEL: That Bill contained no clauses with respect to sulphur purification?

Witness: None whatever.

Had this question of nuisance anything to do with the removal of the company's stations into the country?—Oh, yes; in fact, it was one of the great motives of our going to Parliament to enable us to get to Beckton. The complaints which were made at the Westminster station and the City Gas-Works at Blackfriars, and other stations, rendered it desirable to go away; and the result has been that we have disbanded four stations for the manufacture of gas, simply on account of the nuisance that resulted from keeping the lime in those populous districts.

Examination continued: At the present time, at the various stations where we are obliged to employ lime, the same nuisance is continually arising, and will be, so long as lime is employed for that purpose. I wish to explain to the committee that it is almost impossible to get sulphuric acid by the combustion of gas. [Witness explained some apparatus and made some experiments in illustration of his statement.]

By the COMMITTEE: We all admit that sulphurous acid is produced; but the argument is that it turns into sulphuric acid, and destroys all your articles.

Mr. MICHAEL: You have been now showing the committee experiments of gas burnt under circumstances which are totally diverse from the circumstances which prevail in the ordinary combustion of gas, but even where you have put it under most favourable circumstances, as is shown by the least cloudy bottle, you fail to produce anything but a very small quantity of sulphuric acid?

Witness: That is so.

When you get ammonia present, you put it under different circumstances, and you get a very much larger quantity of sulphuric acid; and, therefore, if there be a quantity of sulphur in the gas, and you have this apparatus in which to burn it, and you have ammonia present, that sulphuric acid may be found?—Yes.

Without that, under ordinary circumstances, no sulphuric acid is found?—No.

Therefore the laboratory experiments you have for determining the quantity of sulphur tell you nothing as to the ordinary circumstances of burning gas in the open air or in the air of an apartment?—Quite so.

You have to prepare something particular in order to produce sulphuric acid, and even then, unless you have got ammonia, it is a very minute quantity?—A mere bagatelle.

Does it not come back to the general question: Is there any sulphuric acid found under ordinary circumstances at all injurious to health, or life, or property?—Most certainly not.

Cross-examined by Mr. O'HARA: I am not a professional chemist, but I know enough of the chemistry of gas lighting to suit my purpose. I am not aware that Mr. Patterson made any discoveries which improved the process of gas-making materially. I have heard of what is called Mr. Patterson's process, and I do not say it is not a desirable process; but I say it is not his process, because it existed ever since lime was used for purification. Mr. Patterson, from his want of practical knowledge of what had been done years ago, thought he had discovered something new.

Mr. O'HARA: At all events, he did think, and other people thought, that he had discovered a new process?

Witness: I never thought so.

You have got your own views upon these matters. Is Mr. Patterson conducting or carrying on a lawsuit, which is now in the House of Lords, about this very process?—Yes; he is appealing from the Court of Appeal.

Therefore, as far as Mr. Patterson's process is a new one or not, the decision of the ultimate question has not been arrived at?—It has not.

In the meantime, you have decided the question in the way you have just told the committee?—In my own opinion, certainly.

You have decided some other things. You have decided that the presence of sulphur in the gas is all a delusion—I mean the hurtful influence of it?—I state nothing but facts. It is not a question of science at all; it is a question of fact, and I contend that if the statements made of the amount of sulphur and its injurious effects are true, it did not want a scientific man to decide it. Any gentleman who has books or pictures can himself tell whether they are destroyed or not.

Do you contend that the question of the presence of a certain amount of sulphur impurity in gas is a delusion in the public mind—the hurtful effects of it?—Certainly, I do.

Had you, between 1869 and 1870, prescribed any limits of impurity as to the sulphur in the gas?—No.

You said that the Metropolitan Board of Works and the Corporation said such things of you that it made your position quite unpleasant; was there any pressure on the part of the public with reference to the non-prescribing of the maximum impurity?—They said so; but the company did not find that their customers complained to them about it. You would think if a man is complaining about his meat being bad, or his wine being bad, he would not go to a person of any other trade; he would go to the man who supplied him with it.

Let me put a hypothetical case. Supposing a man had a house steward, do you not think he would make a representation to him, and not bother himself about running after the butcher, the baker, the tinker, and the candlestick-maker?—We have got many thousands of consumers, and I tell you we never had any complaints from them of the badness of the gas. We know no difference now when the gas is at 20 grains from what it was when it was 30 to 40. The public cannot appreciate it, they know nothing at all about it.

Therefore, you think they ought to have no protection of this kind provided?—I say it is unnecessary, and that all these injurious effects are a delusion, and do not exist; and I believe this, that if the committees in 1860 and in 1868 had had the question put before them in a practical and proper way, they never would have passed 20 grains.

You think that honourable members who are sitting here, if they had had the thing put practically and properly before them, would have arrived at a different decision about the purity of the gas of the Crystal Palace Company?—They might take a very different view from this. I cannot know what is in their minds. I hope they will take a different view in this case, that is all.

Cross-examination continued: In 1860 the Chartered Company made a great fight against the 20 grains which were then put in the Act, but at that time we did not know as much as we do now. In 1868 the great struggle of 1866 and 1867 ended in the passing of the City of London Gas Act. During those years we showed the committee that the knowledge of the amount of sulphur, and of the sulphur question altogether, was very much in the dark. I do not know whether the committee recommended it, or whether we suggested it; but, at any rate, the difficulty was got over by having Referees appointed, but no maximum was fixed by Parliament. I remember the inquiry before Mr. Forster's committee, when it was agreed that the Referees were to remain just as they are now. We did not make a fuss about the purity clause in 1875, because the Referees had not fixed the maximum so low as it is now; and secondly, we had not had experience of the use of lime to the extent we have at present. As soon as we found we could not do it without creating a nuisance, we asked the Referees to allow us a little more sulphur, which they did not do, and that is the reason we are here.

Mr. O'HARA: Last year, when you came to Parliament for a Bill, you inserted that clause in the Bill—it was your own Bill. The Metropolitan Board and the Corporation had a fight with you in Parliament in 1875, and, consequently, in 1876 this Bill was practically your own Bill?

Witness: Quite so.

It was a Bill to be assented to by the Metropolitan Board of Works and the Corporation, as fixing for a definite period the gas question. Do you remember Mr. Burke stating in evidence, in 1875, that all he wanted was finality in this matter?—Yes. Having got what you call finality——

Mr. POPE: That was as regards dividend and money. I do not think Mr. Burke entered into the purity question.

Mr. O'HARA: I think Mr. Burke said, "We shall be very happy to give you this, that, and the other, if you will only let us alone."

Cross-examination resumed: We do not wish to disturb the Act of last year; we only want to repeal two clauses, because they press very harshly against the company.

Mr. O'Hara: Did you intend this settlement last year to be a final settlement, or did you not?

Witness: You cannot tell. Certain things have taken place since then; the maximum has been increased, and the difficulties have been increased. We have amalgamated with the Imperial Company, and the difficulty of getting rid of this refuse lime has now become so great; and that alone, even if there were no nuisance, would be sufficient for the repeal of the Act in that respect.

At what period did your directors resolve to come for this alteration of the law?—I think just before the time that we could give notices. In October.

About the 11th of August, 1876, the settlement or compact between the Metropolitan Board of Works, the Corporation, and The Gaslight and Coke Company had been finally sealed with the Queen's Assent, but within three months of that you made up your minds to come to Parliament to disturb it?—Yes.

Did you in last session make an alteration in the clause that prescribed the penalty for impurity in the supply of gas?—An alteration was made. We showed that it was not fair to take one day, and three days were allowed us.

Why did you not, when you asked to have the law changed in that respect, make those representations that you do now?—Simply because the full effect of this lime question had not been felt; and it has not fully come into operation yet.

Have the Referees, since the passing of the Act, altered the maximum impurity for sulphur compounds?—Certainly not since last year.

Notwithstanding that, you think it right to come to Parliament to ask for an alteration in your Act?—Certainly; because we begin to find that the restrictions placed upon us of the 13 grains, and all that, have necessitated an alteration in our apparatus. We have had to spend a very large sum of money—over £100,000—in new purifiers, in order to meet that. The effect of the alteration and the increased amount of lime was only begun to be felt last year.

Do you say that it was felt between the 11th of August and October?—And before that too.

If it was felt before that, why did not you ask to have a change made in the Act of Parliament?—Because the matter was left to the Referees, and we thought that, taking all the circumstances into consideration, they would then give such a maximum as we could honestly carry out without the use of lime.

The maximum prescribed by the Referees then was the same maximum as is prescribed now?—I am perfectly aware of that, but I gave you a reason why; in order to meet that maximum we had to lay out an immense sum of money to make these purifiers. They take one or two years to make, and they are only now coming fully into operation, but we find that using those purifiers with lime involves such a nuisance that we come here for relief, because the Referees will not give it us. If the Referees had met us and said, "We think there is something in what you say——"

The Committee: I do not understand what your evidence is; as to the requirements of the Referees before last August, what was the purity that they exacted from you previous to August last year?

Witness: 20 and 25, and 15 and 20 grains, the same as now. We have complied with their request as far as we could. Sometimes we ran up a long way, but when the gas examiner came we explained it to him. The great inconvenience we suffered from complying with the order was that we were obliged to use lime to a larger extent. The amount fixed, 15 and 20, and 20 and 25 grains, necessitates the use of lime, which causes a great nuisance. We have experienced greater difficulty since last August because the quantity of gas we have to make is now very largely increased, and, in addition to that, we are using a much larger quantity of lime; whereas, in the way we did it before, we managed to keep it down. Another thing is, that, although they fixed that maximum, we were very often above it, and we could not comply with it. We have never been charged or prosecuted under this clause. On several occasions Dr. Williamson has been down, and he has said, "Seeing the alterations you are making, so as to do away with any risk of going up above the standard, I shall report that you are doing what you can, and I shall recommend you not to be fined." Dr. Williamson is the Chief Gas Examiner.

Cross-examination resumed: In the year 1876 we used nearly 1,100,000 tons of coal, and of lime at the rate of a bushel for every ton.

Mr. O'Hara: Why have you given up the two processes of taking the sulphuretted hydrogen out by means of peroxide of iron and leaving the lime for the other sulphur compounds? Why have you divided the thing in two?

Witness: If you take out the sulphuretted hydrogen from the gas by oxide of iron, how are you to make the sulphide of calcium which acts upon the sulphur compounds? It is very likely that other people are of a different opinion to myself.

In 1867 Mr. Hawksley was asked: "If, therefore, there was a proposal for a new supply at a considerable distance from the inhabited districts, the sanitarian philosophers would not object, and we might have the advantage of using lime for the purification of gas?" His reply was: "Certainly; but I think that a better mode has been discovered than has yet been spoken of, and that is to continue the use of oxide of iron for taking out the sulphuretted hydrogen, and then only using the lime for the purpose of taking out the remaining bisulphide. Now, that is not an offensive process. By the combination of the two processes, my opinion is that the works can be carried on where they are; but the effect of the double process is to incur the cost of about a penny per 1000 feet." What do you say to that? Is that a common practice?—I think Mr. Hawksley has been misreported there.

Let me go a little further, because Mr. Hawksley is here, and I had the advantage of asking him the question before I put it to you. He says he is very well reported. Let me ask you, is that process enunciated by Mr. Hawksley in that answer a common process now?—I am not aware of it. There are some works that are using oxide of iron and lime; but, as a rule, they generally use oxide of iron first. That takes out all the sulphuretted hydrogen, and therefore what is the use of passing the gas through the lime afterwards?

Supposing the lime was so arranged as to take out a portion of the sulphuretted hydrogen, would you still object to it?—That is a totally different thing, and I believe that is what Mr. Hawksley meant.

Suppose you give in your own way what Mr. Hawksley meant, and tell me whether that is a process that can be adopted?—It may be adopted, but still you are bothered with the difficulty of getting rid of the lime; you make much more offensive lime than it would be if the whole of the lime was used.

Cross-examination continued: We gave up using oxide of iron at Beckton four or five years ago, directly the agitation began about this question of sulphur. At Fulham our purifiers are in the open, and I should not advise them to be enclosed.

Mr. O'Hara: Do you think it is better to expose the contents to the wind, and so on, and so discharge them all over the district?

Witness: It is the getting rid of the lime. The lime is taken away in trucks in the open air, so that if the lime was taken out of a purifier which was in a room the exhalations must escape from the windows or openings, so that it is only a question of keeping it in the room for a little time. I do not see any advantage in that at all, and it is injurious to the men. If the Referees had allowed us a few more grains we should very likely have tried to get over the difficulty.

Having had your capital, price, illuminating power, and all those things settled, and everything out of the way, you thought it a good move to come to Parliament this year?—No; you quite mistake the thing. We we were acting under the Referees, and whatever they suggested we carried out. And we say, and have said all along, that if the Referees would only act conscientiously upon that clause in the Act of Parliament we should not have been here now.

The Committee: So far as the Referees have acted conscientiously, they were doing so before you obtained your Bill of last year.

Witness: We did not get to the extent of the nuisance.

When you got your Act of last year you foresaw that you would have an increase of business, and therefore you might have foreseen, whether you did or not, that the public would suffer to that extent from the nuisance?—We amalgamated with the Imperial and with the Independent Companies, and that brought us five more stations.

Still you took your Bill with that clause, and now you come to protect the public against your own Act of Parliament?—You may call it our own, but we say it is the Act of the Referees.

Cross-examination continued: There was a prosecution in connexion with the Bromley works for making a nuisance by the smell of the purifying process, instituted by the West Ham Local Board. There is no way in which we can dispose of this refuse lime to the farmers; the quantity is so large, and the difficulty we meet with in railway trucks so great—in fact, the railway companies will not take it. We shall have a witness here to prove the result of a railway truck being unloaded. It made the people ill. At present there is no difficulty in getting rid of it. We have got this large amount of ground, and we put it there; but in the course of a year or two that will be filled up, and then we shall not know where to go. Another thing is that the farmers do not care about it. We had better put it on our own ground than go to the expense of carriage for taking it away. We do all we can—we give it away; some of the farmers do take a few loads away in the course of the year, but it is not used extensively, and that is the whole question. In country gas-works there is no difficulty; a railway truck would last perhaps a month or two months.

Mr. O'Hara: This lime, affected in this way, if exposed to the air, becomes pure after a certain time, does it not?

Witness: It has not so much smell.

In fact, it becomes innoxious after a little time. Now, the Bromley-by-Bow prosecution, how did that eventuate—did you get a dismissal, or were you condemned?—I think it was decided in our favour.

It was held that you made no nuisance?—Yes.

Re-examined by Mr. Pope: On March 31, 1874, the Gas Referees reduced the standard to its present point; before that it was 20 grains in summer at Beckton, Bow, and Bromley, and 25 at the other works—that would be in September, 1874. The order in March, 1872, was 5 grains more, and the next order, on Sept. 30, 1874, reduced to the present maximum. After August, 1876, complaints were made by the Shoreditch Vestry and the inhabitants of St. George's Square. In consequence of that, before November, 1876, application was made to the Referees to alter the standard of impurity. Finding they did not alter the standard of impurity, we gave notice for this Bill. During the whole of the winter those negotiations with the Referees were continued with a view to induce them to give us the relief sought for, but they were unsuccessful. If they had been successful we should have withdrawn our Bill. In August, 1876, the matter was left with the Referees exactly as it had been before. It is not of the Referees personally that I complain, but the fact that they have formed a view which seems to me not only inconvenient to the public, but unjust to ourselves, and that is the reason we are asking Parliament to rectify it.

By the Committee: I was present here during the hearing of the former case, and heard the evidence of Mr. Loam, of Nottingham. He said there had been some demand for gas refuse from the small farmers in the district. We could not send ours down the river to the Essex marshes, because the agriculturists there would not take it. We advertise it in the public papers, but the quantity is so enormous that we cannot get rid of it. With small works there is no difficulty, but when you come to treat of such enormous quantities as we have to deal with, there is considerable difficulty. I heard Professor Barff's evidence about finding sulphuric acid as a fact, but I have tried all my life to produce it, and cannot do so. This is evidence that my statement is correct. [Referring to one of the samples.] That ought to be covered with acid, and I say the same about books. The effect on the books, I believe, is entirely due to the moisture of hot air. Any one who could produce sulphuric acid by exposing sulphurous acid to the air would make an enormous fortune. The sulphuric acid makers would give anything if it could be done.

The Committee: Suppose, as a matter of fact, there were books in a library in which gas had been burnt, and they had remained on the shelves of that library for some years, and that afterwards a chemist, by washing them, did get off a solution in which sulphuric acid was present, then what should you think?

Witness: I should think very likely it came from the paste. All paste contains alum. I have got three books which were on a shelf alongside a number of other books, and those three books only were attacked, the whole of the binding being destroyed.

Major-General *William Harrison Askwith*, examined by Mr. Pope.

I live in St. George's Square, but formerly resided at Waltham Abbey, where I was superintendent of the gunpowder factory. While resident there, in consequence of spent lime being brought from the gas-works, I became familiar with the character of the offensive smell it possessed. Latterly, myself and the other inhabitants of St. George's Square have been very much annoyed with the smell proceeding from the gas-works at the top of the square.

Mr. Pope: Could you recognize, from your previous acquaintance with spent lime, whether it had any relation to the same sort of smell?

Witness: Exactly the same, and it has been a serious annoyance to the inhabitants, so much so that in November last Mr. Sclater-Booth, myself, and the other inhabitants, presented the following memorial to the company:—

St. George's Square, S.W., Nov. 23, 1876.

Sir,—We, the undersigned, inhabitants of St. George's Square, beg to call your attention to the very serious annoyance that we have received by the mismanagement of the company's Pimlico Gas-Works. In the course of last night lime purifiers were, we believe, opened, and quantities of most offensive gas allowed to escape. The smell caused by this was so great that people were awakened in the night by it; all of us, with our families and servants, have suffered more or less by the nuisance caused by the servants of the company. The smell complained of is not the usual smell, always more or less offensive, to be perceived on passing this station, or when the wind is in the east, but a far more concentrated and sickening smell. Some of us have repeatedly complained, both to the agent to the Square Trustees (Mr. Smith) and to the company's officers, of the state of things committed at this station. The events of last night have occurred several times before, and as we do not intend to allow our families and our-

selves to be made sick, and our property depreciated, by the conduct complained of, unless we have at once some real and satisfactory assurance that this will never be repeated, we shall be compelled to apply to the Court of Chancery for an injunction.

We are, Sir, your obedient servants,

G. SCLATER-BOOTH.

(Signed also by 22 other principal inhabitants of the Square.)

J. O. Phillips, Esq., Secretary.

There is a general complaint about the smell, which was stronger during last winter than during the year before, although it has always been very bad.

Mr. POPE: Is it the general feeling of the inhabitants of the neighbourhood that this really is a substantial nuisance, of which complaint is justifiable?

Witness: In all my communications with them I have understood that it is considered to be a decided nuisance.

Cross-examined by Mr. O'HARA: I have been living in St. George's Square since March, 1868, and the smell has been always very bad. I cannot exactly say when I first made a representation of the unpleasantness to the gas company, but on several occasions during the last three or four years I have done so to the manager of the gas-works; to Mr. Smith, who is agent for Cubitt's people; and to Mr. Dines, from whom I purchased my house. We should have been glad if we could have got rid of the gas-works altogether. I was not aware at that time in what manner it was caused, although I am now aware of it. I was the author of the memorial, and took it round myself for signature.

Mr. O'HARA: Did you ever threaten the gas company that you would indict them, or anything of that sort?

Witness: No; it was mentioned by Mr. Dines, in the course of conversation, that we should do so if we got no redress.

By the COMMITTEE: We received a very civil reply from the company, relative to the Act of Parliament which appointed three Referees, stating also that the gas was to be of a certain purity, and that the Referees did not seem inclined to make any alteration relative to the purity of the gas, and therefore they were bound to use lime for the purification of it. We had made a previous application, and I had a note from Mr. Phillips, the secretary of the gas company, as follows:—

The Gaslight and Coke Company, Horseferry Road, Westminster, S.W., Oct. 30, 1876.

Sir,—I regret very much to learn that you have suffered annoyance at the time our people at the company's Pimlico station were clearing out the lime purifiers.

The system of purification by means of lime now adopted in London gas-works, has been forced upon us by a Government Board called the Gas Referees, with whom the directors are now in communication, with the hope of inducing them to permit some other mode of purification.

In the meantime, I have given the strictest instructions to the engineer, Mr. Kitt, on the subject, and I beg to assure you that no pains shall be spared to prevent further inconvenience to your neighbourhood. I am, Sir, &c.,

J. O. PHILLIPS, Secretary.

Major-General Askwith, 119, St. George's Square.

I had verbally, and frequently, in the course of conversation with Mr. Dines and other people, made complaints about the nuisance for several years back; but the answer I received was that they themselves had represented it to the gas company, but could not get any alteration.

Mr. *George Dines*, examined by Mr. MICHAEL.

I was a builder in Grosvenor Road for many years, but have now retired from business. From 1833 to 1860, I was with the late Mr. Thomas Cubitt and his trustees. I was engaged on their behalf in very large building operations in South Belgravia. I have latterly, on my own account, built in St. George's Square, on a portion of their estate, a large number of houses, and have sold a great many of them. I own a considerable amount of house property there, and in the immediate neighbourhood. The houses in St. George's Square vary at the present moment from a rental of £160 a year to £600 or £700. I should think the average is £240 a year. The east side of the square abuts rather closely on to the works of the late Equitable Gas Company, which was absorbed into The Gaslight and Coke Company. I have known the gas-works for 40 years, and have been in the habit frequently of going through the works.

Mr. MICHAEL: How do you think they manage their works?

Mr. O'HARA: How does he know how gas-works are managed? Is he a gas engineer?

Mr. MICHAEL: Let us have his evidence, at any rate, for what it is worth.

Witness: They were kept very clean and nice, and things looked as if the place was kept as tidy as possible. I remember when the company purified by milk of lime. Thirty years ago, or rather more than that, the nuisance was something frightful on account of the stink. I cannot fix the exact time when that process was abandoned, and oxide of iron used in its place. The nuisance recommenced only a few years back, and there is a nuisance at the present time arising from the lime. I know the smell of sulphuretted hydrogen. I was in the neighbourhood last Friday; I am there every week. I went to the gas company's wharf to see what was being done there. I passed along in front of their works. When I got to the eastward of them—and the wind was blowing from the east—the smell was rather strong, so I thought I would go back, and I did so. The process of conveying the lime into the covered barges was going on, and the smell was very bad. It appeared that every precaution was then being taken to carry out the process without, if possible, creating a nuisance, and I saw the whole process. The purifiers were uncovered, and men were shovelling the stuff out into carts. When the cart was filled, it was covered with 3 inches of breeze or ashes, and was then taken out across the public road to their wharf on the banks of the Thames, where they had a barge with boards over it. A hole was cut in those boards, and a shoot was inserted which came up to the edge of the wharf. It was large enough to put the end of the cart in, and the front of it was covered over with a curtain or tarpauling, but that did not succeed in preventing a nuisance.

Cross-examined by Mr. O'HARA: I used to be a good deal about there when I was building my houses. I finished my last house about two years ago. The gas company get their coal in underneath by a tunnel.

Mr. O'HARA: Did it strike you at all that a tunnel would be a very good way of getting rid of that stuff, instead of bringing it across the public road?

Witness: Yes; they might do it in that way, by means of a barge, but exposing it is a nuisance. It is all over the place in a moment. It cannot be got rid of.

Do you not think that the longer you expose it the more likely is the smell to be offensive? Would you not rather that they tried to keep it underground as long as they could?—They would not let it rest when they got it underground.

Would you bring it across a public road if you could bring it underground?—Decidedly not.

Re-examined by Mr. MICHAEL: I believe that the greatest amount of nuisance is caused when the purifiers are opened and the lime emptied out into the carts.

Mr. MICHAEL: So that the nuisance was not in taking it along the road, but at the time of opening the purifiers and shooting the lime into the covered barge?

Witness: That was when the greatest amount of nuisance was occasioned. But the cart that had it in could be smelt for half a mile off. This is a map of St. George's Square, if the committee would like to see it [producing the same].

By the COMMITTEE: I have seen every brick laid on Eccleston Square. The houses there vary from £240 a year upwards; they are not double.

Sir *Edmund Hay Currie*, examined by Mr. MICHAEL.

I am a distiller, and chairman of the London Hospital. My distillery is situated on the Middlesex side of the river Lea—at Bromley—and my private residence is within 50 yards. I am very much annoyed by the smells from the gas-works. We have other smells, and plenty of them; but those are the worst that come from the gas-works. It is such an intolerable nuisance, that it makes my female servants ill; and the younger members of my brother's family, when they come to see me, are actually sick. I have traced that clearly and distinctly to the gas-works. I have made inquiries to satisfy myself that the gas company did all in their power to prevent the occurrence of the smells; and have always found the company very polite. They never refuse us admission at any time to see their premises. I should say that I have no knowledge whatever of the working of gas companies, and cannot give any information upon that subject, but I speak on behalf of 40,000 or 50,000 people who are suffering from the grievance. I have lived for 23 years in the East-end of London; I am the representative of the district at the School Board for London, and chairman of two or three hospitals, and know the feeling of the inhabitants thoroughly. I know all my neighbours very well. I have made myself acquainted with the circumstances under which this nuisance arises, and understand it is from being obliged to use the process of purification by lime, and we wish that system to be altered.

Cross-examined by Mr. O'HARA: We have been suffering from this nuisance ever since the Bromley Gas-Works were started, which was, I think, about two years ago. I ask the committee to do what they can to relieve my neighbours and myself from a nuisance which is as bad as anything can possibly be, and which renders life very uncomfortable there.

Mr. O'HARA: Let me call your attention to the section of the Act of Parliament the company seek to have repealed. [Section 36 read.] You see, Parliament has taken care of you already.

Witness: I do not see that it gives me any remedy there. What is it?

Mr. O'HARA: By indictment.

Mr. MICHAEL: That he had before.

Mr. O'HARA: Parliament has told the company that they must do a certain thing, but that they must not do it so as to become a nuisance.

Witness: Yes; I see that.

Supposing that this Act of Parliament saved your rights, and preserved you from the nuisance, would not that be satisfactory to you?—I do not quite follow you. My difficulty is that you say I may indict this company. That will cost me a great deal of money. I do not see why I am obliged to do anything of the kind.

You have got 40,000 or 50,000 sympathizers?—But they are poor people.

One shilling each from them would go some way?—Yes; but we have not many shillings to spend down there. At any rate the poor people have not. I think I am the only person at all of any means who lives in that neighbourhood for any distance.

Your contention is that the gas-works should be removed altogether?—No, I do not think so at all. I do not think that follows.

What do you want more than protection against the nuisance, when the Act of Parliament says that they shall not do anything which shall cause a nuisance?—I simply come here to ask the committee if they will be kind enough to consider the position in which we are placed in the East-end of London. The inhabitants there have very great confidence, I believe, in myself, and they ask me to represent that they are suffering from a nuisance of a character which I do not think anybody sitting round this table can have any conception of. I can go and live elsewhere, if I choose, to-morrow morning, but these poor people cannot. They must live near the East and West India Docks, where they get their livelihood.

You represent that there is a nuisance, but you have taken no steps, either at law or otherwise, to put an end to this nuisance. Do you know whether or not the law is sufficient to enable you to put an end to it?—I have not gone so far as that. I have a great hatred of law, and would far sooner come here to see if I can get a remedy in a cheaper manner, by spending half an hour in this committee-room.

I see, you come here to do it cheaply?—I am quite prepared to spend my money in hospitals, and things of that kind, in the East-end of London, but I do not see why I should put my hand in my pocket to spend money in litigation.

Do you not think it would be as well to minister to the health of the people outside the hospitals as well as inside?—I have done that all my life.

Would you not effect that if you were to spend a little money, so as to put the law in force?—No; I do not see it.

Re-examined by Mr. MICHAEL: It is because this clause has not been a sufficient protection to us that I ask the committee to alter it. I do not think any one can have any conception of what we are suffering at the present time.

QUALITY OF THE BIRMINGHAM GAS.—The reports of Mr. Thomas Jackson, the gas examiner, show that during the month of May, at the four gas-making station of the corporation, 19 examinations of the illuminating power of the gas supplied to the borough were made. The maximum light in sperm candles was 18·48; minimum, 16·72; average, 17·41. The parliamentary standard is 15 candles, with Sugg's No. 1 "London" burner.

QUALITY OF THE NEWCASTLE-ON-TYNE GAS.—Mr. John Pattinson reports as the results of his examinations, for the month of May, of the quality of the gas supplied to the borough by the Newcastle-upon-Tyne and Gateshead Gas Company:—

Date.	Illuminating Power in Sperm Candles.	Grains of Sulphur in 100 Cubic Feet of Gas.	Sulphuretted Hydrogen.
May 1	14·9	14·57	Nil.
,, 4	15·0	12·64	,,
,, 8	14·3	7·19	,,
,, 11	13·8	6·38	,,
,, 15	15·0	7·39	,,
,, 18	14·5	7·12	,,
,, 22	14·6	6·04	,,
,, 25	14·8	6·42	,,
,, 29	15·2	7·84	,,

A Sugg-Letheby standard Argand burner is used in testing. According to Act of Parliament, the gas should not be of less than 14 standard candles illuminating power, nor contain more than 17 grains of sulphur per 100 cubic feet of gas.

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